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UNITED STATES AIR FORCE

AIR UNIVERSITY

# AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

# BASE LEVEL CIVIL ENGINEERING EDUCATIONAL NEEDS: A SURVEY EVALUATING DEGREES, DISCIPLINES AND COURSES

William A. Gauntt, Captain, USAF
John F. Stann, Jr., Captain, USAF

LSSR 29-77B

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This thesis surveyed 486 civil engineering base level managers to obtain their opinion on the type of degree and level of education they thought was necessary to do their job. Fifty-four courses were evaluated by the respondents in order to determine which courses would be most helpful to them in performing their mission. The number of respondents who had completed each course was tabulated for those courses they rated as helpful. The survey results showed that military and civilian respondents rated the need for education differently and that, overall, the proportion of master's degrees recommended to do a base level civil engineer's job was not as great as a current job list for Civil Engineering Officers shows.

LSSR 29-77B

# BASE LEVEL CIVIL ENGINEERING EDUCATIONAL NEEDS: A SURVEY EVALUATING DEGREES, DISCIPLINES AND COURSES

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Facilities Management

By

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DATE: 7 September 1977

Ronald E. Kingston

COMMITTEE CHAIRMAN

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# CHAPTER I

# INTRODUCTION

## Problem Statement

There appears to be considerable disagreement with the type of advanced degree required by Air Force Civil Engineering Officers. A 1972 study of civil engineering education requirements stated that 65 percent of graduate degrees for civil engineers should be engineering or technically oriented and 35 percent should be management oriented (14:16). Subsequently, a 1974 thesis research effort concluded that the advanced degrees should be 65 percent management and 35 percent technical or engineering oriented (10:26).

In August 1976 the latest Civil Engineering Officer Job List was published. Of the base level civil engineering positions requiring advanced degrees, 65 percent of the degrees were technically oriented and 35 percent of the advanced degrees were management oriented (13). This ratio of technical to management advanced degrees was in line with the 1972 review, but was counter to the recommendations made in the 1974 research (10). Major General Robert C. Thompson, the Director of Engineering and Services, Headquarters United States Air Force, stated while he was Deputy Director of

Civil Engineering in 1972 that engineers needed to place increased emphasis on management training (10:6); however, he did not say whether the management training was to come through advanced degrees or additional management educational courses. The disagreement is compounded by the fact that there are no written guidelines that list or enumerate specific courses of study or specific subject areas which will help prepare a civil engineering officer or civilian to perform in any civil engineering job. Any written guidance or list that enumerates such courses or subject areas would enable an officer or civilian to better prepare himself to accomplish specific civil engineering jobs. This thesis has examined selected courses and subject areas relevant to civil engineering in an attempt to develop a list of study areas that will help prepare an officer or civilian to accomplish specific civil engineering jobs at the base level.

## Definitions

To provide a common frame of reference, the following terms are defined as they are used in this thesis.

Management. Management is the effective and economical allocation, utilization, and/or control of resources to accomplish predetermined objectives (10:1). The functions of management are defined in Air Force Manual (AFM) 25-1, USAF Management Process, and include the following:

planning, organizing, coordinating, directing and controlling (15:10).

Engineering. As defined in the Model Law prepared by the National Council of Engineering Examiners:

> . . . engineering . . . shall mean any service or creative work the adequate performance of which requires engineering education, training, and experience in the application of special knowledge . . . [7:237].

## Background

The Civil Engineering Officer Job List identifies all officer positions within the USAF Civil Engineering career field (13). There are many positions identified, ranging from air staff positions to squadron level administrative positions. Many of the air staff positions and major command positions indicate unique requirements to fit the individual jobs. There are also some technically oriented positions that may have special educational requirements. Due to the unique character of the various technical jobs and the major command and air staff jobs, the advanced degree requirements of each job must be defined on an individual basis. These jobs are not included in the thesis for this reason.

On the other hand, the majority of the jobs listed, 57 percent, are for base level jobs (13). Most new officers entering civil engineering work at the base level and then throughout their career rotate from staff jobs back into the base level organization. Base level jobs are fairly

standardized, not only because of the large number of these jobs, but also because there are many regulations and manuals governing the specific job requirements. Since the organizations at base level tend to be fairly standard, job responsibilities and duties at this level are almost the same throughout the Air Force.

The 1976 Civil Engineer Officer Job List identified all base level civil engineer officer positions as either commander, branch chief or section level. Table 1 divides these base level positions into the three management levels and shows the educational requirements for each. At the commander level 83 percent require advanced degrees and at the branch chief level 53 percent require advanced degrees. Only 15 percent of the personnel at the section level require advanced degrees, therefore a study of the educational requirements for these individuals would be of less value than a study of the commanders and branch chiefs requirements. For this reason the thesis examines only the two upper levels of management at the base level.

In the two upper levels, there are five primary management positions at the base level. They are the Base Civil Engineer (BCE), the Chief of Operations and Maintenance (O&M), the Chief of Programs, the Chief of Engineering and Construction (E&C), and the Chief of Industrial Engineering. The Industrial Engineer, while filling a manager position, is being excluded from this research since

TABLE 1

BASE LEVEL, CIVIL ENGINEERING OFFICER, ADVANCED DEGREE REQUIREMENTS BY LEVEL OF MANAGEMENT

| LEVEL OF MANAGEMENT | MASTER'S DEGREE | | | | BS | | TOTAL POSITIONS |
|---|---|---|---|---|---|---|---|
| | ENGINEERING | | MANAGEMENT | | ENGINEERING | | |
| | # | % | # | % | # | % | |
| Highest Level (BCE) | 78 | 61.5 | 28 | 21.5 | 21 | 17.0 | 127 |
| MIDDLE LEVEL (BRANCH CHIEFS) | 56 | 21.6 | 81 | 31.3 | 122 | 47.1 | 259 |
| LOWEST LEVEL (SECTIONS) | 95 | 14.2 | 4 | 0.6 | 569 | 85.2 | 668 |
| TOTAL | 229 | 21.7 | 113 | 10.7 | 712 | 67.6 | 1054 |

NOTES:

(1) Figures do not include Industrial Engineering positions.

(2) Data extracted from Civil Engineering Officer Job List, August, 1976.

industrial engineering is defined in AFM 85-38, Civil Engineering Management Review as a staff function which provides management assistance and consultation (12:13). Only the first four management positions at the base level were examined in this thesis.

The first three management positions are generally manned by military personnel and the fourth, the Chief of E&C, is generally a civilian position (9). The 1976 Civil Engineering Officer Job List identifies 386 middle manager and commander positions, of which 243, or 63 percent, require advanced degrees. All others, or 37 percent, require a bachelor's degree. Table 2 breaks the master's level requirements into two categories, management and engineering. A third category consists of positions requiring only a bachelor's degree. The categories defined in the job list as management type degrees included Engineering Management (1AGY) and Facilities Management (1AGA) (13:4). All other degrees were identified as engineering degrees with the exception of industrial engineering degrees.

The reason bachelor's degrees are required for 37 percent of the management positions at the base level may be explained by one of the conclusions of Meri-Akri and Walton's research in 1974. They stated that a bachelor's degree in engineering is ample technical education to permit performance of the majority of engineering work required of Air Force civil engineer officers (10:25).

TABLE 2

BASE LEVEL, CIVIL ENGINEERING OFFICER, ADVANCED DEGREE REQUIREMENTS FOR SPECIFIC MANAGEMENT POSITIONS

| BASE LEVEL MANAGEMENT POSITIONS | MASTER'S DEGREE | | | | BS ENGINEERING | | TOTAL POSITIONS |
|---|---|---|---|---|---|---|---|
| | MANAGEMENT | | ENGINEERING | | | | |
| | # | % | # | % | # | % | |
| Base Civil Engineer FAC 4400 | 28 | 21.5 | 78 | 61.5 | 21 | 17.0 | 127 |
| Chief, Programs Branch FAC 4410 | 31 | 29.0 | 29 | 27.0 | 48 | 44.0 | 108 |
| Chief, Engineering and Construction FAC 4420 | 2 | 10.0 | 8 | 37.0 | 11 | 53.0 | 21 |
| Chief, Operations and Maintenance FAC 4430 | 48 | 37.0 | 19 | 15.0 | 63 | 48.0 | 130 |
| TOTAL | 109 | 28.3 | 134 | 34.7 | 143 | 37.0 | 386 |

NOTE: Data extracted from Civil Engineering Officer Job List, August, 1976.

There is no readily available data to determine how many of the civilian positions require advanced degrees, but it is known that like the military, the civilians have some need for advanced or higher education; therefore, this thesis examined the degree requirements for base level civil engineering managers, both military and civilian, in the four primary management positions.

## Justification

There are several reasons that an investigation of the advanced educational requirements for the four primary management positions was undertaken. The most obvious was to try to resolve the disagreement surrounding the advanced educational needs of civil engineering managers. Secondly, by evaluating the educational need of each position as expressed by the civil engineers currently in those positions, we were able to then compare it to the specified educational level and degree of each of the four primary base level management positions expressed in the 1976 Civil Engineering Officer Job List. A third reason for evaluating educational requirements was to determine if the people currently in those positions have the appropriate education in order to properly do their job. Finally, undertaking such a study provided the opportunity to determine what specific subject areas individuals need to obtain the appropriate education. Further explanations of each

of these reasons will be examined separately in this section.

The confusion about advanced educational requirements for a civil engineer is due to the fact that he is basically an engineer although he is continually being called upon to be a better manager. The 1972 Civil Engineer Panel of the Air Force Educational Requirements Board stated the engineer-manager dichotomy like this:

> Engineering masters degree requirements reflect the continuing growing complexity in facility design and construction. The emphasis on engineering management reflects the concern of commands for engineers to make the transition from engineer to engineer-manager. Since there is a major effort in civil engineering to improve the productivity of the technical work force, the transition must prepare engineers to use new computer systems and programs, for financial management, for programming of new facilities requirements, budgeting and quality control [14:15].

They addressed the problem by recommending a greater percentage of management type advanced degrees for civil engineers, which were subsequently approved by the Air Force Educational Requirements Board (14:8). The degree mix that was approved is presented in Table 3.

While the educational board considered this an optimal mix, they did not identify the management positions that should have the additional management degrees. The latest allocation of these management degrees as expressed in the 1976 job list appears to be on a random basis since some positions identified as needing the advanced management

TABLE 3

FIVE YEAR ADVANCED ACADEMIC DEGREE REQUIREMENT
FOR AIR FORCE CIVIL ENGINEER OFFICERS

| Discipline | Advanced Degree Requirement in Percent of Total C.E. Officer Force |
|---|---|
| Architect/Arch.-Engineering | 2% |
| Civil Engineering | 9 |
| Environmental Engineering | 5 |
| Electrical Engineering | 5 |
| Mechanical Engineering | 5 |
| Industrial Engineering | 5 |
| Facilities Management | 4 |
| Engineering Management | 5 |
| | 40% |

Source: Report of the Civil Engineer Panel of the Air Force Educational Requirements Board, 1972.

degree are also identified at other bases as needing either an advanced engineering degree or no advanced degree at all. By surveying individuals in specific management positions it may be possible to clarify the mix of management/engineering degrees for each position.

An analysis of the job requirements for the military positions shown in Table 2 reveals some interesting data concerning the educational need of a CE as stated in the 1976 job list. Of the four jobs being discussed, 63 percent of the positions require or recommend a master's level education. None of the positions recommends doctoral level education. The job list of academic specialty codes also breaks the advanced academic degrees required into

nine degree programs. Of the nine degrees recommended, three are management degrees and six are engineering degrees (13).

As discussed earlier, only the four primary management positions are considered the important managers of the organization, and an analysis of the distribution of management-related and engineering-related advanced degrees at the base level confirms this. At the lowest level of management in the CE organization, the section level, not many advanced degrees are required. As illustrated in Table 1 only 14.8 percent of the section level positions require an advanced degree, and 95 out of 99 advanced degrees required are engineering-related advanced degrees. At the middle level of management, the Chiefs of O&M, E&C, and Programs, 52.9 percent of the positions require an advanced degree and 81 of the 137 positions requiring an advanced degree or 59 percent of the degrees are management-related. The figures for the lowest and middle levels are in agreement with the expectations of modern management theorists who say that the closer the supervisor is to the operating level the more he will need to be technically qualified (8:438). The further the manager is removed from the operating level the more management training he will need (6:125). The interesting information that the table reveals is that in the CE organization, the BCE, who is the manager the furthest from the operating level, is required

to be more technically educated since 78 of the 106 or 74 percent of the advanced degree BCE positions required engineering degrees as opposed to management degrees. This does not agree with the modern concept that the higher level manager requires more management education (8:438), thus the reevaluation of the academic specialty coding for the BCE and middle manager positions was undertaken.

The third reason for investigating educational requirements was to determine if the individuals currently holding these positions have the appropriate education in order to properly do their job. Educational development and evaluation is an important means of insuring that the educational needs of an individual and his organization are met and the individual's promotion potential is increased. The Civil Engineer Panel of the Air Force Educational Requirements Board summed it this way:

> The explosion of engineering technology and the changing demands of society, the Air Force, and the combat forces demand professional engineering competence. To accommodate this almost constant change, education must be a way of life to the engineer and engineer-manager. Much updating can be accomplished through AFIT short courses, part-time study, and professional military schools [14:8].

The panel continues to say that full-time graduate study is the best way to provide a high degree of competence in complex engineering disciplines. They also recognized that at some point the transition from engineer to engineer-manager must be made, and they subsequently

increased the number of management-related master's degree programs for civil engineering officers while encouraging off-duty study (14:18). The increase in management-related degrees was accomplished, however, without an in-depth analysis of specific positions that require management expertise. Meri-Akri and Walton also recommend, in their 1974 thesis results, that all positions requiring an advanced engineering degree be identified through a survey, and then all other positions requiring advanced degrees be management-type degrees to ". . . provide the management skills necessary to enable the Air Force civil engineer officer to efficiently perform the duties of his position [10:26]."

Although identifying all other advanced degree positions as management-related may be good, it may be impossible to educate all civil engineering officers as managers at Air Force expense. Most of them will usually be in a management position at one time or another during their career; so continuing education and off-duty education programs may be the best way for some officers to prepare themselves as managers. Unfortunately, they do not have a guide that tells them what courses are best suited to prepare them as managers. Thus, by determining the advanced educational needs of civil engineering officers, it should also be possible to determine a list of courses that will help prepare officers to be better managers.

Another benefit of such a list of courses was stated by a former director of the Air Force Civil Engineering School, who indicated that the results of a survey of civil engineers who rated courses according to need would be beneficial in helping to formulate the curriculum of the CE Continuing Career Education Program (9). He also stated that it would be of benefit to know how many civil engineers have had certain courses to determine if there is a need to develop such a course. In a personal interview with a faculty member of the AFIT School of Systems and Logistics (AFIT/LS), an interest was expressed in using the results of a rating of the educational needs of civil engineer managers as a variable in evaluating the content of the *Facilities Management* program at AFIT/LS (1).

## Research Objectives

The goal of this research effort was to identify the education subject areas needed to increase the capabilities of the base level civil engineering staff. As an aid in attaining this goal, the following objectives were established:

1. Determine a recommended education; i.e., degree level, discipline, and listing of recommended or required subject areas, by position for the following base level civil engineering positions:

a. Base Civil Engineer
b. Chief, Programs Branch
c. Chief, Engineering and Construction Branch
d. Chief, Operations and Maintenance Branch

2. Determine an approximate percentage of base level civil engineering staff members, military and civilian, who have had each of the needed courses.

3. Provide AFIT's School of Systems and Logistics and Civil Engineering School with a list of subject areas, that civil engineers expressed a need for, to help the schools determine the courses to be offered students working in the 55XX career field.

4. Determine if the four base level civil engineering management positions are coded with the proper academic specialty codes.

## Research Questions

The research data generated for this thesis effort was used to answer the following questions:

1. How do civil engineering staff members rate the relative usefulness of certain selected subject areas in performing the following jobs?

a. Base Civil Engineer
b. Chief, Programs Branch
c. Chief, Engineering and Construction Branch
d. Chief, Operations and Maintenance Branch

2. From the ratings of the selected subject areas, which subject areas can be inferred to be required subject areas needed to perform each of the four jobs?

3. From the ratings of the selected subject areas, which subject areas can be inferred to be subject areas not needed to perform each of the four jobs?

4. What do civil engineering staff members feel is the required education in terms of degree level and discipline for the following jobs?

a. Base Civil Engineer
b. Chief, Programs Branch
c. Chief, Engineering and Construction Branch
d. Chief, Operations and Maintenance Branch

5. How do the results of question 4 compare to the required academic specialty codes listed in the 1976 Civil Engineering Officer Job List?

6. What percentage of the base level civil engineering staff members have had each of the needed courses?

# CHAPTER II

# METHOD

## Introduction

In order to determine the answers to the research questions and ultimately satisfy the research objectives, the authors decided to rely on the opinions and beliefs of individuals currently in the four base level civil engineering management positions. Since questioning the individuals directly or through a questionnaire is the only way to obtain an individual's opinion and beliefs (5:199), the authors decided to use a questionnaire because it is more economical than personally interviewing individuals spread across a broad geographic area.

A questionnaire was developed for this thesis and is similar in construction to that used in several previous research efforts (4; 11). The questionnaire collected both descriptive data and personal opinions. The validity of the questionnaire had been established in two ways. First, the questionnaire was similar to questionnaires used in previous research efforts. Secondly, the questionnaire was administered to a test group of individuals familiar with both the academic environment and the base level civil engineering environment.

## Questionnaire

The questionnaire constructed for this thesis was designed to obtain descriptive information and personal opinions concerning the usefulness of certain courses and subject areas to base level civil engineering managers. The questionnaire was in three sections. Section A consisted of eight questions and obtained the descriptive information that was used to qualify the respondent as a valid respondent. Section B listed 54 advanced educational courses that might be applicable to civil engineering managers. Each course was defined in a brief course description, with the respondent rating the course on a scale of usefulness from one to ten. Section C consisted of a listing of the same courses and was designed to determine how many individuals have had each course. All answers were marked on an AF Form 223, a computer grading sheet, by the respondents and the computer sheets were machine graded by an optical scanner. A copy of the questionnaire is included in Appendix D.

The questionnaire was constructed in the following manner. The first four questions of Section A collected descriptive information and questions 5 through 8 obtained some individual opinions. The courses that were briefly described in questions 9 through 62 were carefully selected. Catalogs for eleven major colleges and universities across the country were used to help determine the subject areas

that are included in both management and engineering curriculums. In addition, courses taught by AFIT at the graduate level were included. These AFIT courses were considered essential to answer research question number 8. The other major university catalogs that were consulted included:

1. Georgia Tech
2. Stanford University
3. Texas A&M University
4. University of California at Los Angeles
5. University of Colorado
6. University of Dayton
7. University of Michigan
8. University of Pennsylvania
9. University of Texas
10. University of Wisconsin
11. Virginia Polytechnic Institute

Section C was a listing of the courses included in Section B and each respondent was asked if he had the course or a similar course at the graduate or undergraduate level and where he completed the course--in a formal school, by correspondence, or through PME.

After the questionnaire was administered to a sample group of civil engineers, and their comments considered, it was put into final form and formal approval requested to conduct the survey. After approval was obtained from the Military Personnel Center at Randolph AFB, Texas, the survey was mailed to the appropriate positions at eighty-nine bases.

## Population and Sample

The population consists of the four base level management positions at all Air Force bases. Due to the fact that assignments within the Air Force were continually changing and that qualified personnel within each branch frequently take charge of the branch when the branch chief is on leave or TDY, the sample will also include the deputy BCE and the deputy branch chief positions.[1] Data from a deputy position was considered valid if the incumbent had worked in the branch at least one year.

There are currently 148 major Air Force bases worldwide (2:138). Of this number only 108 have all four of the management positions. Twenty of these bases are overseas and since some deputy positions could be occupied by foreign nationals, it was decided to exclude overseas bases because of possible language and educational equivalence problems. The sample, therefore, was limited to the 8 management positions at 89 Air Force bases in the continental United States, or 712 possible positions.

The 1976 job list does not identify deputy or civilian positions, but the following military positions are identified and it is assumed that all branch chief positions not listed in the job list are occupied by civilians.

---

[1]Officially, there is no deputy branch chief; however, for the purposes of this research, he is defined as the person who fills in or acts for the branch chief during his absence.

| | Military | Civilian |
|---|---|---|
| Base Civil Engineer/Deputy | 91 | - |
| Chief of O&M | 84 | 4 |
| Chief of Programs | 77 | 11 |
| Chief of E&C | 3 | 85 |

No estimate was made of the military civilian mix in the deputy positions (13).

## Data Analysis

A computer program was developed as a part of this research effort. This program, written in FORTRAN IV, automatically performed all grouping, summarization, ranking, and tabulating of the course ratings.

Questions 9 through 62 were the list of the 54 selected subject areas, where each respondent rated each subject area on an interval scale from 1 to 10. A response of 1 indicated no need for the subject area, and a response of 10 indicated that the subject area was required. Responses between 1 and 10 indicated varying degrees of need of usefulness. The ratings for each subject area were summed by position. The subject area's mean rating for each position was then calculated. These means were then tested for significance, and the results listed by position in descending order of mean values. The result can be seen in Appendix B.

## Statistical Test

A parametric statistical test for significance was used on the data collected in response to questions 9 through 62. It was assumed that the responses to questions 9 through 62 were independent, the populations were normally distributed with equal variances, and the scale was interval (5:380).

The test was a Z test to test the computed mean rating of each subject area for each position to see if the mean was either significantly higher than an arbitrarily selected upper parameter or significantly lower than an arbitrarily selected lower parameter. The Z test was selected instead of the t test because the sample size for each position was at least 100. The upper and lower parameters were selected at the points that mark the upper and lower thirds of the scale. On the 1 to 10 scale these points are at 4.00 for the lower and 7.00 for the upper parameters. The computer program calculated the following for each subject area in each group:

a. $n$ = sample size for each position.

b. $\bar{X}$ = the mean rating of each subject area for each position.

c. $S$ = the standard deviation of the ratings of each subject area for each position.

d. $\alpha$ = the confidence level for each test of significance.

e. $Z$ = the test statistic where:

1. For $\bar{X} > 7.00$ $\quad Z = \dfrac{\bar{X} - 7.00}{S/\sqrt{n}}$

2. For $4.00 \leq \bar{X} \leq 7.00$ $\quad Z = 0.00$

3. For $\bar{X} < 4.00$ $\quad Z = \dfrac{\bar{X} - 4.00}{S/\sqrt{n}}$ (3.267)

The hypotheses used in each test of significance were:

For the upper level of 7.00:

$H_0$: $\bar{X} \leq 7.00$ or the course is not very useful.

$H_1$: $\bar{X} > 7.00$ or the course is very useful.

For the lower level of 4.00:

$H_0$: $\bar{X} \geq 4.00$ or the course has a little use.

$H_1$: $\bar{X} < 4.00$ or the course is not needed.

## Assumptions

In order to conduct a statistical analysis of the data obtained from the respondents of the questionnaire, the following assumptions were made (5:380):

1. The observations were independent. That is, the individual responses were considered independent responses.

2. The observations were drawn from normally distributed populations.

3. The populations had equal variances.

4. The measure scale used in the questionnaire was at least interval.

# CHAPTER III

# QUESTIONNAIRE RESULTS

## Introduction

Of the 712 questionnaires mailed to the 89 different Air Force bases, 552 were returned, for a 77.5 percent gross response rate. The responses to questions 1 through 6 were compiled and the results arranged in tables to present the information. The first question in the questionnaire identified the respondent's management position. columns 2 and 3 of Table 4 show the number and percentages of questionnaires returned and columns 4 and 5 show the number and percentage of usable questionnaires broken down by question one, the respondent's management position.

The difference in the number returned and the number usable is equal to the number of deputies who had worked in the job for less than one year plus the 37 questionnaires which were returned unanswered. This left a net response rate or usable rate of 68.3 percent. Twenty-nine questionnaires were returned where the deputy had less than one year on the job. These questionnaires were excluded because it was felt that these individuals might not have adequate experience in the job to properly rate the usefulness of the courses.

TABLE 4

QUESTIONNAIRE RESPONSE RATES FOR SPECIFIC MANAGEMENT POSITIONS

| LEVEL OF MANAGEMENT | SURVEYS SENT OUT | RETURNED[a] | | USABLE[b] | | |
|---|---|---|---|---|---|---|
| | | # | % OF SENT OUT | # | % OF SENT OUT | % OF TOTAL USABLE |
| Base Civil Engineer | 178 | 149 | 83.7% | 137 | 77.0% | 28.2% |
| Chief of Programs | 178 | 144 | 80.9 | 123 | 69.1 | 25.3 |
| Chief of Operations & Maintenance | 178 | 116 | 65.2 | 100 | 56.2 | 20.6 |
| Chief of Engineering & Construction | 178 | 140 | 78.7 | 126 | 70.8 | 25.9 |
| TOTAL | 712 | 552[c] | 77.5 | 486 | 68.3 | - |

[a]Includes all surveys returned, answered and unanswered.

[b]Includes only those who had worked in the job over one year.

[c]Includes three surveys with no position identified.

The last column in Table 4 shows by percent how the usable questionnaires were distributed by management position. In each case the percent usable was close to 25 percent of the total usable questionnaires for each management position.

## Tests for Bias

When any questionnaire is administered, an important factor to consider is whether or not the questionnaire results are biased. In order to check for bias in the questionnaire results, several previously designed computer programs were used. Specific subgroups within each management position were evaluated to see if any of them rated courses significantly higher or lower than the group. The subgroups included time in civil engineering, military or civilian respondents, educational level of the respondents, and the recommended level of education. An additional check was conducted to see if the sequence in which the courses were listed in the survey caused any bias in the responses.

The check for bias between groups with different levels of experience in civil engineering looked at four groups; those with less than one year, from 1 to 12 years, from 13 to 24 years, and those with over 24 years experience. None of the groups rated courses or recommended

disciplines significantly different; therefore, it was concluded that time in civil engineering introduced no bias.

The educational level of the respondents was grouped into three subgroups for evaluation. They were: less than a bachelor's degree, bachelor's degree, and those with a master's degree or more. It should be noted that four individuals indicated they had a Ph.D. None of the subgroups evaluated any of the courses significantly different or recommended a significantly different distribution of degree levels or degree disciplines.

An evaluation of those subgroups recommending different levels of education was also conducted using three subgroups, those recommending less than a bachelor's degree, a bachelor's degree, and a master's degree. No significant differences were found here either.

When the military and civilian subgroups of each management position were evaluated, however, some significant differences were found. The military subgroup recommended more courses as being important and consequently recommended a higher level of education as being required. The data did not allow a detailed examination behind this difference, but it may be that most military individuals feel a higher education improves their promotion potential while the civilians are not hampered by the up or out policy of the Air Force. Since there was a difference in how the military and civilian managers rated both the

courses and the need for a higher education, the tables in Appendices A, B, and C were compiled showing both military and civilian results and a total of both. This also facilitated an evaluation of the educational needs of military civil engineers surveyed as compared to the 1976 job list for military civil engineers.

The last check for bias was to see if the sequence in which courses were listed in the survey caused any bias. Results show that courses in the last half of the questionnaire were rated both as high and low as courses in the first half; therefore, it was concluded that no bias was present.

## Specific Results

After all of the questionnaire results were tabulated by the computer, tables were constructed showing the results of questions 2 through 6 and the course ratings for each position. The tables are in Appendices A and B and the following discussion is designed to highlight some important points about each of them.

Question 2 identified the rank and or grade of the respondents. Because of the bias discussed earlier, this question allowed the respondents to be classified as either military or civilian. The breakdown of question 2 is found in Table 6. The results show that 44.4 percent of the respondents were military and 55.4 percent of the

respondents were civilians. The missing 0.2 percent represents one respondent who did not answer question 2. The "percent of total" column shows the percent of military or civilian in each management position. The low number of military Chiefs of Engineering and Construction was expected since a total of only 21 positions are listed in the 1976 Civil Engineering Officer Job List.

Question 3, the time in Air Force Civil Engineering of each respondent is found in Table 7. The results show that 113 or 52 percent of the military surveyed had from 1 to 8 years of experience, contrasted to 186 or 69 percent of the civilians who had over 17 years experience. Forty-seven percent of the civilian managers surveyed had over 20 years experience.

Question 4 was used to determine the highest educational level of the respondents. The information presented in Table 8 was grouped into four categories which included: those with less than a bachelor's degree, those with a bachelor's degree, those with a bachelor's degree plus some graduate work, and last, those with a master's degree of more. An interesting fact shown by Table 8 is that the three educational levels--bachelor's, bachelor's plus some master's and master's--are almost equally distributed.

Question 5, recommended educational level, is illustrated in Table 9 and shows that most respondents

indicated that the proper educational level for their position was a Bachelor of Science Degree (65.5 percent), while only 23.4 percent of the respondents felt that a master's degree was required to do their job. This result was similar to the results obtained in an earlier thesis (9:25). A larger percentage of military respondents felt that a master's degree was required, possibly for the bias discussed earlier.

The combined results of questions 4 and 5 are compared in Figure 1 on the next page. The percentages of recommended and attained degree levels are nearly the same for both the civilians at the master's level and the military at the bachelor's level. At the master's level, however, the military have more degrees than recommended, while the civilians at the bachelor's level have fewer than recommended.

The results obtained from question 6, recommended educational discipline, are illustrated in Table 10 of Appendix A. They show that 35 percent of the respondents felt a general engineering degree was required while 24.7 percent felt a management degree was required to do their job. No conclusions concerning the appropriate degree and level of degree should be drawn at this time. A later analysis will develop this idea. The table also shows the number of respondents who indicated a preference for a particular degree. In addition to the degrees shown in the

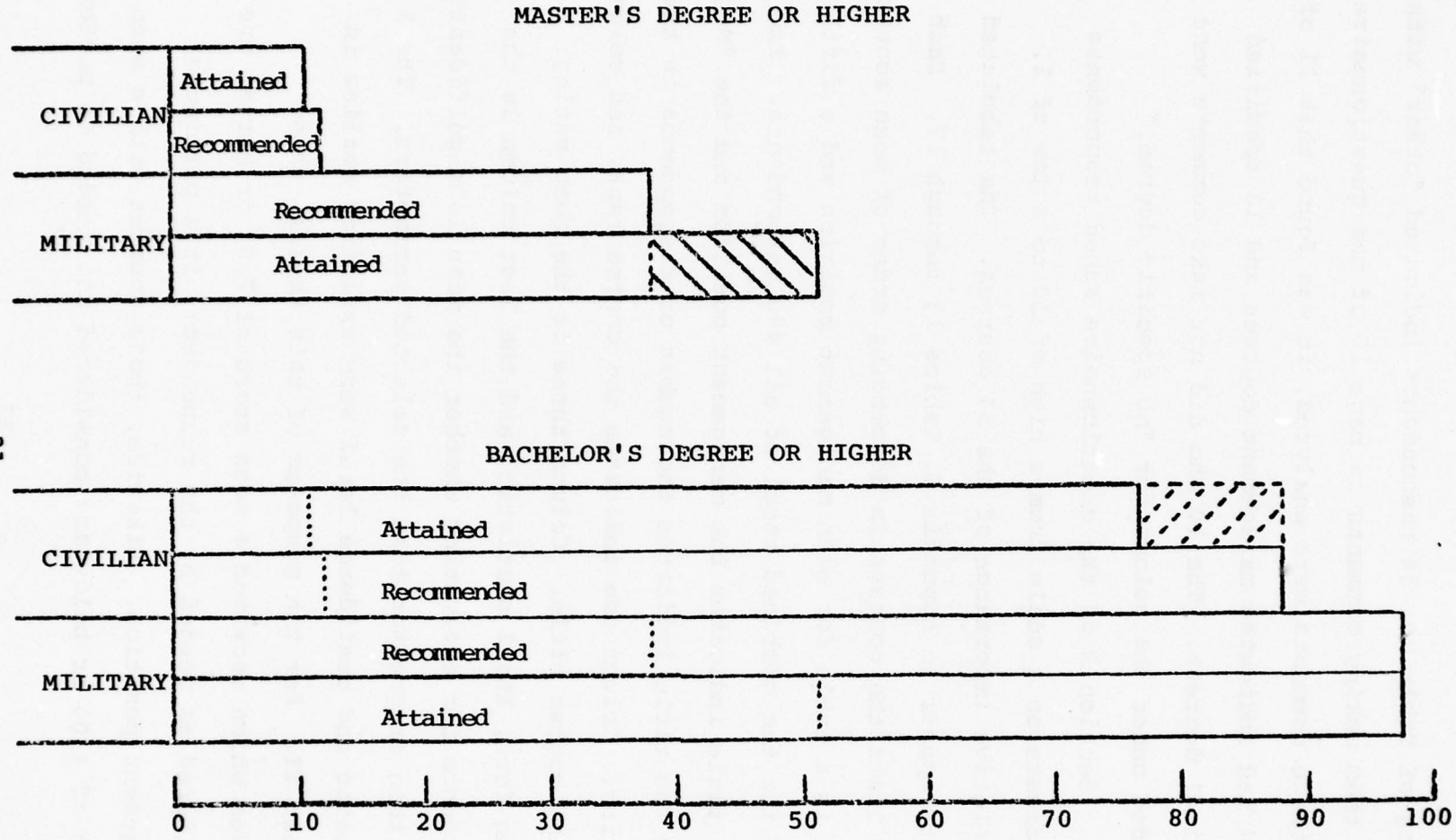


Fig. 1. Comparison of Attained versus Recommended Degree Levels

heading of Table 10, 34 respondents indicated "other" with 24 of them making comments on page 16 of the questionnaire. When these comments were analyzed, it was found that 11 of the 24 had indicated management degrees and 13 specified technical degrees. The 10 who did not make comments were included under the column for "no specific degree."

Section B of the questionnaire asked respondents to indicate on a scale from a high of 10 to a low of 1, the relative importance of the 54 courses. The tabulated results appear in Appendix B, Tables 13 through 17. Each table lists the courses in descending order of mean scores. There is a table for each management position and a fifth table for the combined total of all 486 respondents. The table title indicates the management position and the "N=" below the title indicates the number of respondents in that position. Column one indicates the course rank, and column two the course title. Column three is the mean rating; column four, the Z statistic; and the last column is the confidence for evaluating whether the mean is significantly less than or greater than the selected parameters. The Z statistic and confidence level were explained earlier in Chapter II. For the purposes of this thesis, those courses which received a mean score of 7.00 or better are considered as needed by the respondents in a particular management position. Likewise, those courses with a mean score of 4.00 or below are considered not needed to perform

in a particular management position. As an example, the Base Civil Engineers expressed a high need for a course entitled Human Factors in Administration which ranked as number 1 with a mean score of 7.78 (Table 13). They also expressed a low need for a course entitled Statistics II ranked as number 54 with a mean score of 3.28 (Table 13). The Base Civil Engineers rated 14 courses with a mean of 7.00 or above while respondents in Programs, O&M and E&C rated 7, 11, and 5 courses respectively with a mean of 7.00 or above. The number of courses with a mean rating of 4.00 or below for BCE, Programs, O&M, and E&C were respectively 6, 6, 9, and 7. Table 17 shows that the number of courses with an overall mean rating of 7.00 or above was 7 and those with a mean rating of 4.00 or below was 6. These courses are those that were considered as either needed or not needed by the total group of respondents.

The results of questions 63 through 116 will be discussed later in the general results section.

## General Results

One of the original objectives of this thesis was to determine a recommended education, that is, degree level, discipline, and a listing of some recommended subject areas, for each of the four primary management positions. To do this, the results of questions 5 and 6,

Tables 9 and 10, were meshed and the resultant matrix analyzed further. Tables 11 and 12 in Appendix A show the resulting tabulation of the recommended disciplines at the two major levels of education, bachelor's degree and master's degree. Of the three disciplines that were recommended at the BS/BA level of education, the largest with 63.7 percent was a technical discipline. Nineteen percent felt that a management degree was necessary while others, 17.3 percent, felt that no specific degree discipline was necessary, but at least a bachelor's degree was required. Table 12 shows the different disciplines that were recommended at the master's degree level. Overall, 23 percent of the respondents felt a master's degree was required. The largest percentage of these respondents, 42.1 percent, said that management should be the recommended discipline, while 23.7 percent said a general engineering degree at the master's level was recommended.

Analysis of Table 11 indicates that 69.1 percent of the respondents said that only a bachelor's degree was sufficient and that 63.7 percent of these degrees (40 percent overall) should be technical degrees.

Only 23 percent said a master's degree was recommended, but the percentage of management degrees increased from 19.0 percent at the bachelor level to 42.1 percent at the master's level while the percentage of technical degrees decreased from 63.7 percent to 48.3 percent

respectively. The general results indicate then that although some master's degrees in either management or general engineering are required, most of the respondents felt that a bachelor's degree in a technical area was sufficient education for their position.

The second objective of this thesis was to determine the approximate percentage of civil engineering managers that had completed the courses listed in the questionnaire. The results of Section C of the questionnaire indicated the percentage of respondents who had completed each of the courses. Tables 18 through 22 in Appendix C list this percentage along with the percentage of military and the percentage of civilians who have had those courses with an overall mean rating of 7.00 or above. There are five tables, one for each management position and one for all 486 respondents. Those percentages that are enclosed within parenthesis indicate that group or subgroup of respondents that did not have a course mean rating of 7.00 or above. As an example of how to read the tables, consider the Energy Conservation course which was highly recommended by Base Civil Engineers. Table 18 shows that only 34.3 percent had completed such a course prior to the survey. Table 22 also shows that only 29.6 percent of all respondents had completed such a course prior to the survey. This would indicate that the course is considered important, but has not been completed by 70 percent of

the respondents. The last page of the questionnaire asked for additional comments concerning courses that had not been listed, and the usefulness or importance of the information derived from this questionnaire. Over 60 percent of the respondents (334) submitted comments. Only one subject area, Personnel and Executive Management, was listed by a significant number of respondents (31) as being excluded from the questionnaire. On the subject of the usefulness of the information, the comments ranged from a nomination for a "Golden Fleece" award to "An extremely useful way to help determine what subject areas Air Force Civil Engineering requires to do its job." Most of the comments, however, indicated the survey would only be useful <u>if</u> the results were acted on by appropriate Air Force agencies.

# CHAPTER IV

# CONCLUSIONS

## Discussion

Although the results of the questionnaire cannot be used to generalize about all of Air Force Civil Engineering, some inferences can be made. Before presenting the conclusions, however, an important fact to remember is that the questionnaire and the results pertain to only four management positions at base level. Six conclusions were drawn from the questionnaire results.

The first, from Table 11, is that at least some individuals should not be prohibited from entering civil engineering because they do not have the benefit of an engineering degree. Table 11 shows that approximately 63.7 percent of civil engineering managers needing a bachelor's degree feel that their degree should be in an engineering discipline. The remaining 36.3 percent feel that a degree in management or some other area is sufficient to accomplish their job. This implies that a requirement to have an engineering degree prior to entering Air Force Civil Engineering may be too stringent and some individuals expressing a desire to be in civil engineering, but not possessing an engineering degree, should be allowed

to become Air Force Civil Engineers. The conclusion then is that most, but not all, individuals entering Air Force Civil Engineering should have at least a bachelor's degree in an engineering discipline.

The second, from Table 12, is that the base level management positions needing master's level education need as many non-technical as technical degrees. Table 9 shows that the percentage of individuals recommending a master's degree to do their job was 23.4 percent. Table 12 then shows how the recommended disciplines for these master's degrees were distributed with 48.3 percent recommending engineering degrees, 42.1 percent recommending management degrees, and 9.6 percent no specific discipline. This totals 48.3 percent technical and 51.7 percent non-technical.

The third, from Tables 8 and 9, is that, for those surveyed, there were more military managers with master's degrees than military jobs needing master's degrees. This conclusion was obtained by comparing the results of questions 4 and 5. Table 9 shows that only 23.4 percent of the respondents felt a master's degree was recommended to do their job while from Table 8, 29.6 percent of the respondents said they had a master's degree. Breaking it down further and looking at the military separately, it was found that only 38 percent of the positions need a master's

degree, but over 51 percent of the military managers filling those positions have a master's degree.

Conclusion four is that five courses were rated as being needed and also found to have been completed by less than 50 percent of the respondents. This conclusion is based on the results of questions 9 through 116. Table 22 indicates those courses that were most recommended by all four management positions and also shows the percentage of the total respondents that had completed each course. From this table it can be seen that five of the needed courses had been completed by less than 50 percent of the respondents. These courses were:

| Course Name | % Completed |
|---|---|
| 1. Energy Conservation | 29.6 |
| 2. Contracting for Civil Engineers | 47.4 |
| 3. Environmental Resources Management | 25.8 |
| 4. Financial Management | 49.7 |
| 5. Economic Analysis for CEs | 45.3 |

Conclusion five is that there were six courses that were rated as being of little value to the base level civil engineering manager. Tables 13, 14, 16 and 17 list the courses that were given mean ratings less than 4.0. The following six courses were rated below 4.00 on all four tables:

1. Micro Economics for Defense Planning
2. Probability and Statistics
3. Distribution Management
4. Principles of Accounting
5. Research
6. Statistics II

The last conclusion was based on a comparison of the job list and the military respondent's answers to questions 5 and 6 in the questionnaire. The results of the military respondent's answers did not support the degree levels and disciplines shown in the job list. Table 5 presents this comparison. The most significant percentages in Table 5 are those that appear in the "total percentage" row. The military respondents are shown separately since the job list included military officers only. A major difference between the job list and the questionnaire responses was that the military indicated a need for a management degree at the bachelor's level. Another difference is that the military also indicated that some degrees at both bachelor's and master's levels required no specific discipline. Of special significance is the fact that the military's percentage of both management and technical degrees at the master's level were approximately equal and lower than the job list's percentages. This lower percentage of master's level degrees corresponded to a higher percentage of bachelor's level degrees.

## Summary

1. Most, but not all, individuals entering Air Force Civil Engineering should have at least a bachelor's degree in an engineering discipline.

TABLE 5

COMPARISON BETWEEN THE JOB LIST AND THE SURVEY RESULTS OF CIVIL ENGINEERING OFFICER, ADVANCED DEGREE REQUIREMENTS FOR SPECIFIC MANAGEMENT POSITIONS

| LEVEL OF MANAGEMENT | | MASTER'S DEGREE | | | BACHELOR'S DEGREE | | |
|---|---|---|---|---|---|---|---|
| | | Mgmt Degree | Engr Degree | No Specific Degree | Mgmt Degree | Tech Degree | No Specific Degree |
| BASE CIVIL ENGINEER | Job List | 21.5 | 61.5 | - | - | 17.0 | - |
| | Military | 18.9 | 21.7 | 11.6 | 8.7 | 26.1 | 13.0 |
| | Mil/Civ | 11.0 | 16.8 | 5.8 | 10.9 | 41.6 | 13.9 |
| PROGRAMS BRANCH | Job List | 29.0 | 27.0 | - | - | 44.0 | - |
| | Military | 22.9 | 4.3 | 1.4 | 27.1 | 31.5 | 12.9 |
| | Mil/Civ | 17.1 | 4.5 | 1.8 | 27.0 | 40.6 | 9.0 |
| O&M BRANCH | Job List | 37.0 | 15.0 | - | - | 48.0 | - |
| | Military | 13.3 | 16.7 | - | 15.0 | 38.3 | 16.7 |
| | Mil/Civ | 11.4 | 16.5 | - | 13.9 | 45.6 | 12.6 |
| E&C BRANCH | Job List | 10.0 | 37.0 | - | - | 53.0 | - |
| | Military | 16.7 | 50.0 | - | 8.3 | 25.0 | - |
| | Mil/Civ | 4.1 | 11.4 | 0.8 | 6.5 | 61.8 | 15.4 |
| TOTAL PERCENTAGE | Job List | 28.3 | 34.7 | - | - | 37.0 | - |
| | Military | 18.5 | 16.1 | 4.2 | 16.6 | 31.3 | 13.3 |
| | Mil/Civ | 10.6 | 12.2 | 2.4 | 14.2 | 47.8 | 12.8 |

2. The base level management positions needing master's level education need as many non-technical as technical degrees.

3. For those surveyed, there were more military managers with master's degrees than military jobs needing master's degrees.

4. There were five courses that were rated as being needed and also found to have been completed by less than 50 percent of the respondents. They were:

a. Energy Conservation

b. Contracting for Civil Engineers

c. Environmental Resources Management

d. Financial Management

e. Economic Analysis for CEs

5. There were six courses that were rated as being of little value to the base level civil engineering manager. They were:

a. Micro Economics for Defense Planning

b. Probability and Statistics

c. Distribution Management

d. Principles of Accounting

e. Research

f. Statistics II

6. The military respondent's answers to questions 5 and 6 did not support the degree levels and disciplines shown in the 1976 Civil Engineering Officer's Job List.

# CHAPTER V

## RECOMMENDATIONS

1. The Air Force should consider the feasibility of admitting into the 55XX career field, officers with other than an undergraduate engineering degree.

2. Since it was concluded that the civilian respondents perceived a need for additional higher education, the area of education for the civilian civil engineering managers should be given additional study.

3. Education curriculums offered to civil engineering managers should be evaluated in light of the needed and not needed courses recommended by the questionnaire results.

4. Since the results of the questionnaire did not support the educational requirements for base level managers listed in the 1976 Civil Engineering Officer's Job List, the areas in conflict should be given additional study.

5. A listing of the courses recommended by the results of the questionnaire should be made available to individuals who are or will be in the 55XX career field, so that they can be made aware of the specific courses that are considered highly needed by civil engineering managers.

# APPENDICES

# APPENDIX A

## RESULTS OF QUESTIONNAIRE SECTION A

TABLE 6

NUMBER OF RESPONDENTS BY POSITION AND MILITARY/CIVILIAN RANK OR GRADE

| LEVEL OF MANAGEMENT | MILITARY | | | | | | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|
| | 0-6 | 0-5 | 0-4 | 0-3 | 0-2 | 0-1 | Other | No. | % |
| Base Civil Engineer | 32 | 30 | 5 | 2 | 0 | 0 | 0 | 69 | 50.4 |
| Chief of Programs | 0 | 13 | 24 | 28 | 3 | 1 | 2 | 71 | 57.7 |
| Chief of Operations & Maintenance | 0 | 25 | 25 | 6 | 1 | 2 | 5 | 64 | 64.6 |
| Chief of Engineering & Construction | 0 | 1 | 2 | 7 | 2 | 0 | 0 | 12 | 9.5 |
| TOTAL NO. | 32 | 69 | 56 | 43 | 6 | 3 | 7 | 216 | |
| TOTAL % | 6.6 | 14.2 | 11.5 | 8.8 | 1.2 | 0.6 | 1.5 | | 44.4 |

NOTE: One O&M did not answer Question 2.

TABLE 6 --Continued

| LEVEL OF MANAGEMENT | CIVILIAN | | | | | | TOTAL | |
|---|---|---|---|---|---|---|---|---|
| | GS-14 | GS-13 | GS-12 | GS-11 | GS-10 | Other | No. | % |
| Base Civil Engineer | 17 | 50 | 1 | 0 | 0 | 0 | 68 | 49.6 |
| Chief of Programs | 0 | 6 | 23 | 22 | 1 | 0 | 52 | 42.3 |
| Chief of Operations & Maintenance | 0 | 2 | 4 | 0 | 0 | 29 | 35 | 35.4 |
| Chief of Engineering & Construction | 9 | 59 | 41 | 5 | 0 | 0 | 114 | 90.5 |
| TOTAL NO. | 26 | 117 | 69 | 27 | 1 | 29 | 269 | |
| TOTAL % | 5.3 | 24.1 | 14.2 | 5.6 | 0.2 | 6.0 | | 55.4 |

NOTE: One O&M did not answer Question 2.

TABLE 7

NUMBER OF RESPONDENTS BY POSITION AND TIME IN AIR FORCE CIVIL ENGINEERING

| LEVEL OF MANAGEMENT | | LESS THAN 1 YEAR | 1 TO 8 YEARS | 9 TO 16 YEARS | 17 TO 20 YEARS | 21 TO 24 YEARS | OVER 24 YEARS |
|---|---|---|---|---|---|---|---|
| BASE CIVIL ENGINEER | Military | 2 | 26 | 14 | 16 | 7 | 4 |
| | Civilian | 0 | 4 | 16 | 13 | 16 | 19 |
| PROGRAMS BRANCH | Military | 9 | 41 | 15 | 6 | 0 | 0 |
| | Civilian | 0 | 4 | 13 | 12 | 13 | 10 |
| O&M BRANCH | Military | 4 | 37 | 14 | 4 | 4 | 1 |
| | Civilian | 0 | 1 | 3 | 3 | 9 | 19 |
| E&C BRANCH | Military | 0 | 9 | 1 | 2 | 0 | 0 |
| | Civilian | 0 | 13 | 29 | 30 | 22 | 20 |
| TOTAL | Military | 15 | 113 | 44 | 28 | 11 | 5 |
| | Civilian | 0 | 22 | 61 | 58 | 60 | 68 |
| COMBINED TOTAL IN PERCENT | | 3.1 | 27.8 | 21.6 | 17.7 | 14.6 | 15.2[a] |

[a]Includes one O&M who did not answer Question 2.

TABLE 8

NUMBER OF RESPONDENTS BY POSITION AND HIGHEST LEVELS OF EDUCATION ATTAINED

| LEVEL OF MANAGEMENT | | LESS THAN BACHELOR'S DEGREE | BACHELOR'S DEGREE ONLY | BACHELOR'S DEGREE + SOME | MASTER'S DEGREE OR MORE[a] |
|---|---|---|---|---|---|
| BASE CIVIL ENGINEER | Military | 0 | 16 | 13 | 40 |
| | Civilian | 5 | 25 | 27 | 11 |
| PROGRAM BRANCH | Military | 1 | 14 | 17 | 39 |
| | Civilian | 17 | 19 | 10 | 6 |
| O&M BRANCH | Military | 5 | 13 | 17 | 29 |
| | Civilian | 32[b] | 0 | 1 | 2 |
| E&C BRANCH | Military | 0 | 1 | 5 | 6 |
| | Civilian | 9[b] | 49 | 45 | 11 |
| TOTAL | Military | 6 | 44 | 52 | 114 |
| | Civilian | 63 | 93 | 83 | 30 |
| COMBINED TOTAL IN PERCENT | | 14.4[c] | 28.2 | 27.8 | 29.6 |

[a]Includes 4 Ph.D. degrees.

[b]Includes one who did not answer Question 4.

[c]Includes one O&M who did not answer Question 2.

TABLE 9

NUMBER OF RESPONDENTS BY POSITION AND RECOMMENDED LEVELS OF EDUCATION

| LEVEL OF MANAGEMENT | | LESS THAN BACHELOR'S DEGREE | BACHELOR OF ARTS | BACHELOR OF SCIENCE | MASTER OF ARTS | MASTER OF SCIENCE |
|---|---|---|---|---|---|---|
| BASE CIVIL ENGINEER | Military | 0 | 2 | 31 | 9 | 27 |
| | Civilian | 0 | 0 | 58 | 4 | 6 |
| PROGRAMS BRANCH | Military | 1 | 3 | 47 | 16 | 4 |
| | Civilian | 11 | 4 | 31 | 4 | 2 |
| O&M BRANCH | Military | 4 | 0 | 42 | 10 | 8 |
| | Civilian | 16 | 6 | 9 | 4 | 0 |
| E&C BRANCH | Military | 0 | 0 | 4 | 3 | 5 |
| | Civilian | 3 | 3 | 96 | 5 | 7 |
| TOTAL | Military | 5 | 5 | 124 | 38 | 44 |
| | Civilian | 30 | 13 | 194 | 17 | 15 |
| COMBINED TOTAL IN PERCENT | | 7.4[a] | 3.7 | 65.5 | 11.3 | 12.1 |

[a]Includes one O&M who did not answer Question 2.

TABLE 10

NUMBER OF RESPONDENTS BY POSITION AND RECOMMENDED EDUCATIONAL DISCIPLINES

| LEVEL OF MANAGEMENT | | GENERAL ENGINEERING DEGREE | CIVIL ENGINEERING DEGREE | OTHER ENGINEERING DEGREES | MANAGEMENT DEGREE | NO SPECIFIC DEGREE |
|---|---|---|---|---|---|---|
| BASE CIVIL ENGINEER | Military | 15 | 14 | 4 | 19 | 17 |
| | Civilian | 30 | 9 | 8 | 10 | 11 |
| PROGRAMS BRANCH | Military | 18 | 7 | 1 | 35 | 10 |
| | Civilian | 19 | 6 | 4 | 18 | 5 |
| O&M BRANCH | Military | 23 | 6 | 4 | 17 | 14 |
| | Civilian | 13 | 6 | 1 | 8 | 7 |
| E&C BRANCH | Military | 5 | 3 | 1 | 3 | 0 |
| | Civilian | 47 | 25 | 12 | 10 | 20 |
| TOTAL | Military | 61 | 30 | 10 | 74 | 41 |
| | Civilian | 109 | 46 | 25 | 46 | 43 |
| COMBINED TOTAL IN PERCENT | | 35.0 | 15.8[a] | 7.2 | 24.7 | 17.3 |

[a]Includes one O&M who did not answer Question 2.

TABLE 11

NUMBER OF RESPONDENTS BY POSITION AND RECOMMENDED BACHELOR'S DEGREE DISCIPLINES

| LEVEL OF MANAGEMENT | | TECHNICAL DEGREE | MANAGEMENT DEGREE | NO SPECIFIC |
|---|---|---|---|---|
| BASE CIVIL ENGINEER | Military | 18 | 6 | 9 |
| | Civilian | 39 | 9 | 10 |
| PROGRAMS BRANCH | Military | 22 | 19 | 9 |
| | Civilian | 23 | 11 | 1 |
| O&M BRANCH | Military | 23 | 9 | 10 |
| | Civilian | 13 | 2 | 0 |
| E&C BRANCH | Military | 3 | 1 | 0 |
| | Civilian | 73 | 7 | 19 |
| TOTAL | Military | 66 | 35 | 28 |
| | Civilian | 148 | 29 | 30 |
| PERCENT PER DISCIPLINE | | 63.7[a] | 19.0 | 17.3 |

[a]Includes two with no position identified but recommending engineering degree.

TABLE 12

NUMBER OF RESPONDENTS BY POSITION AND RECOMMENDED MASTER'S DEGREE DISCIPLINES

| LEVEL OF MANAGEMENT | | GENERAL ENGINEERING DEGREE | CIVIL ENGINEERING DEGREE | OTHER ENGINEERING DEGREES | MANAGEMENT DEGREE | NO SPECIFIC DEGREE |
|---|---|---|---|---|---|---|
| BASE CIVIL ENGINEER | Military | 5 | 9 | 1 | 13 | 8 |
| | Civilian | 5 | 1 | 2 | 2 | 0 |
| PROGRAMS BRANCH | Military | 3 | 0 | 0 | 16 | 1 |
| | Civilian | 1 | 0 | 1 | 3 | 1 |
| O&M BRANCH | Military | 4 | 3 | 3 | 8 | 0 |
| | Civilian | 1 | 2 | 0 | 1 | 0 |
| E&C BRANCH | Military | 3 | 2 | 1 | 2 | 0 |
| | Civilian | 5 | 1 | 2 | 3 | 1 |
| TOTAL | Military | 15 | 14 | 5 | 39 | 9 |
| | Civilian | 12 | 4 | 5 | 9 | 2 |
| PERCENT PER DICSIPLINE | | 23.7 | 15.8 | 8.8 | 42.1 | 9.6 |

# APPENDIX B

# RESULTS OF QUESTIONNAIRE SECTION B

## Appendix B Explanation

a. N = the number of usable respondents.

b. Column 1. Rank--each of the 54 courses is listed with the course receiving the highest mean rating listed as number one and the course receiving the lowest mean rating being listed as number 54.

c. Column 2. Course Name--self explanatory.

d. Column 3. Mean--is the sum of all ratings for each course divided by the number of respondents (N).

e. Column 4. Z--the Z statistic is calculated and used to find the confidence level in a normally distributed population.

f. Column 5. Conf--the confidence level, expressed in percent, is the confidence that the mean rating is significantly less than or greater than the selected parameter.

TABLE 13

COURSE RANKING BY MEAN FOR THE BASE CIVIL ENGINEER
N =137

| RANK | COURSE NAME | MEAN($\bar{X}$) | Z | CONF |
|---|---|---|---|---|
| 1 | HUMAN FACTORS IN ADMINISTRATION | 7.78 | 4.660 | 99% |
| 2 | CONTRACTING FOR CIVIL ENGINEERS | 7.77 | 4.882 | 99% |
| 3 | ENERGY CONSERVATION | 7.72 | 4.448 | 99% |
| 4 | FINANCIAL MANAGEMENT | 7.64 | 4.376 | 99% |
| 5 | MANAGERIAL GOAL SETTING | 7.62 | 3.644 | 99% |
| 6 | COMMUNICATIONS IN ORGANIZATIONS | 7.57 | 3.142 | 99% |
| 7 | ORGANIZATIONAL MANAGEMENT: BEHAVIOR | 7.55 | 3.283 | 99% |
| 8 | SPEECH FOR MILITARY MANAGERS | 7.43 | 2.167 | 95% |
| 9 | LEADERSHIP THEORY AND APPLICATION | 7.36 | 2.268 | 95% |
| 10 | FEDERAL LABOR RELATIONS MANAGEMENT | 7.26 | 1.370 | 90% |
| 11 | PRINCIPLES OF COUNSELING | 7.25 | 1.395 | 90% |
| 12 | ENVIRONMENTAL RESOURCES MANAGEMENT | 7.11 | 0.683 | 70% |
| 13 | MANAGING SMALL GROUPS IN ORGANIZATIONS | 7.06 | 0.335 | 60% |
| 14 | ORGANIZATIONAL MANAGEMENT: STRUCTURE | 7.01 | 0.083 | 50% |
| 15 | ECONOMIC ANALYSIS FOR CE'S | 6.99 | 0. | 50% |
| 16 | PERSONNEL MANAGEMENT | 6.76 | 0. | 50% |
| 17 | ORGANIZATIONAL & INDUSTRIAL PSYCHOLOGY | 6.57 | 0. | 50% |
| 18 | MANAGERIAL CONTROLS | 6.47 | 0. | 50% |
| 19 | HUMAN FACTORS IN AF WORK ENVIRONMENT | 6.27 | 0. | 50% |
| 20 | REPORT WRITING | 6.15 | 0. | 50% |
| 21 | POLLUTION CONTROL | 6.12 | 0. | 50% |
| 22 | MAINTENANCE MANAGEMENT | 6.09 | 0. | 50% |
| 23 | INDUSTRIAL SAFETY | 5.99 | 0. | 50% |
| 24 | FACILITIES PLANNING | 5.91 | 0. | 50% |
| 25 | ENGINEERING CONSTRUCTION MANAGEMENT | 5.77 | 0. | 50% |
| 26 | URBAN PLANNING | 5.71 | 0. | 50% |
| 27 | PROJECT MANAGEMENT | 5.69 | 0. | 50% |

TABLE 13 CONTINUED

COURSE RANKING BY MEAN FOR THE BASE CIVIL ENGINEER
N =137

| RANK | COURSE NAME | MEAN($\bar{X}$) | Z | CONF |
|---|---|---|---|---|
| 28 | COST PLANNING AND CONTROL | 5.61 | 0. | 50% |
| 29 | FIRE PROTECTION SYSTEMS DESIGN | 5.55 | 0. | 50% |
| 30 | PAVEMENT DESIGN | 5.49 | 0. | 50% |
| 31 | QUALITY CONTROL | 5.42 | 0. | 50% |
| 32 | COST ACCOUNTING AND MANAGEMENT CONTROL | 5.38 | 0. | 50% |
| 33 | WATER SUPPLY AND WASTE TREATMENT | 5.28 | 0. | 50% |
| 34 | QUANT ANALYSIS FR ENGINEERING MANAGEMENT | 5.17 | 0. | 50% |
| 35 | CORROSION AND CORROSION CONTROL | 5.13 | 0. | 50% |
| 36 | INDUSTRIAL TRAINING | 5.06 | 0. | 50% |
| 37 | ELECTRICAL POWER SYSTEMS & DISTRIBUTION | 5.04 | 0. | 50% |
| 38 | LIFE CYCLE COST | 5.01 | 0. | 50% |
| 39 | SYSTEMS/OPERATIONS RESEARCH | 4.77 | 0. | 50% |
| 40 | BUILDING ANATOMY | 4.72 | 0. | 50% |
| 41 | ARCHITECTURAL DESIGN | 4.72 | 0. | 50% |
| 42 | COMPUTER APPLICATIONS FOR ENGINEERS | 4.57 | 0. | 50% |
| 43 | AIRPORT PLANNING AND DESIGN | 4.50 | 0. | 50% |
| 44 | PRINCIPLES OF AIR CONDITIONING | 4.46 | 0. | 50% |
| 45 | STRUCTURAL DESIGN AND ANALYSIS | 4.21 | 0. | 50% |
| 46 | TRANSPORTATION SYSTEMS DESIGN | 4.12 | 0. | 50% |
| 47 | METHODS AND STANDARDS ANALYSIS | 4.10 | 0. | 50% |
| 48 | AUTOMATIC CONTROL SYSTEMS | 4.02 | 0. | 50% |
| 49 | MICRO ECONOMICS FOR DEFENSE PLANNING | 3.93 | -0.400 | 60% |
| 50 | PRINCIPLES OF ACCOUNTING | 3.72 | -1.614 | 90% |
| 51 | PROBABILITY AND STATISTICS | 3.69 | -1.744 | 95% |
| 52 | DISTRIBUTION MANAGEMENT | 3.57 | -2.472 | 99% |
| 53 | RESEARCH | 3.34 | -3.795 | 99% |
| 54 | STATISTICS II | 3.28 | -4.345 | 99% |

TABLE 14

COURSE RANKING BY MEAN FOR THE CHIEF OF OPERATIONS & MAINTENANCE
N =100

| RANK | COURSE NAME | MEAN($\bar{X}$) | Z | CONF |
|---|---|---|---|---|
| 1 | INDUSTRIAL SAFETY | 8.08 | 5.886 | 99% |
| 2 | HUMAN FACTORS IN ADMINISTRATION | 7.85 | 3.865 | 99% |
| 3 | ENERGY CONSERVATION | 7.79 | 3.908 | 99% |
| 4 | PRINCIPLES OF COUNSELING | 7.59 | 3.192 | 99% |
| 5 | ORGANIZATIONAL MANAGEMENT: BEHAVIOR | 7.38 | 1.850 | 95% |
| 6 | HUMAN FACTORS IN AF WORK ENVIRONMENT | 7.37 | 1.794 | 95% |
| 7 | PERSONNEL MANAGEMENT | 7.29 | 1.257 | 80% |
| 8 | MANAGERIAL GOAL SETTING | 7.15 | 0.682 | 70% |
| 9 | COMMUNICATIONS IN ORGANIZATIONS | 7.06 | 0.280 | 60% |
| 10 | LEADERSHIP THEORY AND APPLICATION | 7.02 | 0.117 | 50% |
| 11 | FEDERAL LABOR RELATIONS MANAGEMENT | 7.01 | 0.046 | 50% |
| 12 | ORGANIZATIONAL MANAGEMENT: STRUCTURE | 6.98 | 0. | 50% |
| 13 | MAINTENANCE MANAGEMENT | 6.89 | 0. | 50% |
| 14 | ENVIRONMENTAL RESOURCES MANAGEMENT | 6.82 | 0. | 50% |
| 15 | ECONOMIC ANALYSIS FOR CE'S | 6.75 | 0. | 50% |
| 16 | WATER SUPPLY AND WASTE TREATMENT | 6.68 | 0. | 50% |
| 17 | SPEECH FOR MILITARY MANAGERS | 6.63 | 0. | 50% |
| 18 | MANAGING SMALL GROUPS IN ORGANIZATIONS | 6.62 | 0. | 50% |
| 19 | ORGANIZATIONAL & INDUSTRIAL PSYCHOLOGY | 6.53 | 0. | 50% |
| 20 | ELECTRICAL POWER SYSTEMS & DISTRIBUTION | 6.46 | 0. | 50% |
| 21 | CORROSION AND CORROSION CONTROL | 6.42 | 0. | 50% |
| 22 | INDUSTRIAL TRAINING | 6.17 | 0. | 50% |
| 23 | QUALITY CONTROL | 6.16 | 0. | 50% |
| 24 | PAVEMENT DESIGN | 6.16 | 0. | 50% |
| 25 | MANAGERIAL CONTROLS | 6.10 | 0. | 50% |
| 26 | FINANCIAL MANAGEMENT | 5.99 | 0. | 50% |
| 27 | BUILDING ANATOMY | 5.72 | 0. | 50% |

TABLE 14 CONTINUED

COURSE RANKING BY MEAN FOR THE CHIEF OF OPERATIONS & MAINTENANCE
N =100

| RANK | COURSE NAME | MEAN($\bar{X}$) | Z | CONF |
|---|---|---|---|---|
| 28 | PRINCIPLES OF AIR CONDITIONING | 5.69 | 0. | 50% |
| 29 | COST PLANNING AND CONTROL | 5.69 | 0. | 50% |
| 30 | CONTRACTING FOR CIVIL ENGINEERS | 5.51 | 0. | 50% |
| 31 | REPORT WRITING | 5.38 | 0. | 50% |
| 32 | POLLUTION CONTROL | 5.24 | 0. | 50% |
| 33 | COST ACCOUNTING AND MANAGEMENT CONTROL | 5.15 | 0. | 50% |
| 34 | FIRE PROTECTION SYSTEMS DESIGN | 4.97 | 0. | 50% |
| 35 | AUTOMATIC CONTROL SYSTEMS | 4.95 | 0. | 50% |
| 36 | METHODS AND STANDARDS ANALYSIS | 4.83 | 0. | 50% |
| 37 | QUANT ANALYSIS FR ENGINEERING MANAGEMENT | 4.83 | 0. | 50% |
| 38 | ENGINEERING CONSTRUCTION MANAGEMENT | 4.73 | 0. | 50% |
| 39 | PROJECT MANAGEMENT | 4.56 | 0. | 50% |
| 40 | STRUCTURAL DESIGN AND ANALYSIS | 4.56 | 0. | 50% |
| 41 | LIFE CYCLE COST | 4.52 | 0. | 50% |
| 42 | FACILITIES PLANNING | 4.46 | 0. | 50% |
| 43 | SYSTEMS/OPERATIONS RESEARCH | 4.40 | 0. | 50% |
| 44 | ARCHITECTURAL DESIGN | 4.30 | 0. | 50% |
| 45 | COMPUTER APPLICATIONS FOR ENGINEERS | 4.06 | 0. | 50% |
| 46 | DISTRIBUTION MANAGEMENT | 3.92 | -0.401 | 60% |
| 47 | AIRPORT PLANNING AND DESIGN | 3.67 | -1.405 | 90% |
| 48 | TRANSPORTATION SYSTEMS DESIGN | 3.63 | -1.773 | 95% |
| 49 | PROBABILITY AND STATISTICS | 3.58 | -2.115 | 95% |
| 50 | URBAN PLANNING | 3.47 | -2.564 | 99% |
| 51 | MICRO ECONOMICS FOR DEFENSE PLANNING | 3.26 | -3.742 | 99% |
| 52 | RESEARCH | 3.19 | -3.606 | 99% |
| 53 | PRINCIPLES OF ACCOUNTING | 3.10 | -4.564 | 99% |
| 54 | STATISTICS II | 2.96 | -5.201 | 99% |

TABLE 15

COURSE RANKING BY MEAN FOR THE CHIEF OF PROGRAMS
N =123

| RANK | COURSE NAME | MEAN($\bar{X}$) | Z | CONF |
|---|---|---|---|---|
| 1 | FINANCIAL MANAGEMENT | 8.00 | 5.351 | 99% |
| 2 | HUMAN FACTORS IN ADMINISTRATION | 7.48 | 2.658 | 99% |
| 3 | COMMUNICATIONS IN ORGANIZATIONS | 7.36 | 1.827 | 95% |
| 4 | SPEECH FOR MILITARY MANAGERS | 7.29 | 1.438 | 90% |
| 5 | ECONOMIC ANALYSIS FOR CE'S | 7.17 | 0.844 | 80% |
| 6 | MANAGERIAL GOAL SETTING | 7.10 | 0.545 | 70% |
| 7 | MANAGING SMALL GROUPS IN ORGANIZATIONS | 7.07 | 0.330 | 60% |
| 8 | ORGANIZATIONAL MANAGEMENT: STRUCTURE | 6.95 | 0. | 50% |
| 9 | PRINCIPLES OF COUNSELING | 6.92 | 0. | 50% |
| 10 | ENERGY CONSERVATION | 6.87 | 0. | 50% |
| 11 | PERSONNEL MANAGEMENT | 6.86 | 0. | 50% |
| 12 | CONTRACTING FOR CIVIL ENGINEERS | 6.85 | 0. | 50% |
| 13 | REPORT WRITING | 6.80 | 0. | 50% |
| 14 | LEADERSHIP THEORY AND APPLICATION | 6.73 | 0. | 50% |
| 15 | ENVIRONMENTAL RESOURCES MANAGEMENT | 6.72 | 0. | 50% |
| 16 | ORGANIZATIONAL MANAGEMENT: BEHAVIOR | 6.67 | 0. | 50% |
| 17 | FACILITIES PLANNING | 6.61 | 0. | 50% |
| 18 | ORGANIZATIONAL & INDUSTRIAL PSYCHOLOGY | 6.48 | 0. | 50% |
| 19 | COST ACCOUNTING AND MANAGEMENT CONTROL | 6.47 | 0. | 50% |
| 20 | MANAGERIAL CONTROLS | 6.44 | 0. | 50% |
| 21 | MAINTENANCE MANAGEMENT | 6.26 | 0. | 50% |
| 22 | URBAN PLANNING | 5.93 | 0. | 50% |
| 23 | PROJECT MANAGEMENT | 5.84 | 0. | 50% |
| 24 | COST PLANNING AND CONTROL | 5.74 | 0. | 50% |
| 25 | HUMAN FACTORS IN AF WORK ENVIRONMENT | 5.66 | 0. | 50% |
| 26 | POLLUTION CONTROL | 5.62 | 0. | 50% |
| 27 | QUANT ANALYSIS FR ENGINEERING MANAGEMENT | 5.60 | 0. | 50% |

TABLE 15 CONTINUED

COURSE RANKING BY MEAN FOR THE CHIEF OF PROGRAMS
N =123

| RANK | COURSE NAME | MEAN($\bar{X}$) | Z | CONF |
|---|---|---|---|---|
| 28 | FEDERAL LABOR RELATIONS MANAGEMENT | 5.51 | Ø. | 50% |
| 29 | INDUSTRIAL TRAINING | 5.51 | Ø. | 50% |
| 30 | ENGINEERING CONSTRUCTION MANAGEMENT | 5.41 | Ø. | 50% |
| 31 | SYSTEMS/OPERATIONS RESEARCH | 5.24 | Ø. | 50% |
| 32 | QUALITY CONTROL | 5.20 | Ø. | 50% |
| 33 | LIFE CYCLE COST | 5.16 | Ø. | 50% |
| 34 | COMPUTER APPLICATIONS FOR ENGINEERS | 4.93 | Ø. | 50% |
| 35 | BUILDING ANATOMY | 4.83 | Ø. | 50% |
| 36 | PRINCIPLES OF ACCOUNTING | 4.76 | Ø. | 50% |
| 37 | INDUSTRIAL SAFETY | 4.72 | Ø. | 50% |
| 38 | MICRO ECONOMICS FOR DEFENSE PLANNING | 4.71 | Ø. | 50% |
| 39 | FIRE PROTECTION SYSTEMS DESIGN | 4.62 | Ø. | 50% |
| 40 | PAVEMENT DESIGN | 4.53 | Ø. | 50% |
| 41 | ARCHITECTURAL DESIGN | 4.48 | Ø. | 50% |
| 42 | AIRPORT PLANNING AND DESIGN | 4.46 | Ø. | 50% |
| 43 | DISTRIBUTION MANAGEMENT | 4.46 | Ø. | 50% |
| 44 | PROBABILITY AND STATISTICS | 4.43 | Ø. | 50% |
| 45 | WATER SUPPLY AND WASTE TREATMENT | 4.29 | Ø. | 50% |
| 46 | TRANSPORTATION SYSTEMS DESIGN | 4.17 | Ø. | 50% |
| 47 | METHODS AND STANDARDS ANALYSIS | 4.17 | Ø. | 50% |
| 48 | CORROSION AND CORROSION CONTROL | 4.15 | Ø. | 50% |
| 49 | ELECTRICAL POWER SYSTEMS & DISTRIBUTION | 3.98 | -Ø.127 | 99% |
| 50 | RESEARCH | 3.91 | -Ø.445 | 60% |
| 51 | PRINCIPLES OF AIR CONDITIONING | 3.82 | -0.952 | 80% |
| 52 | STATISTICS II | 3.79 | -1.Ø12 | 80% |
| 53 | STRUCTURAL DESIGN AND ANALYSIS | 3.62 | -1.935 | 95% |
| 54 | AUTOMATIC CONTROL SYSTEMS | 3.6Ø | -2.ØØ3 | 95% |

TABLE 16

COURSE RANKING BY MEAN FOR THE CHIEF OF ENGINEERING-CONSTRUCTION
N =126

| RANK | COURSE NAME | MEAN($\bar{X}$) | Z | CONF |
|---|---|---|---|---|
| 1 | CONTRACTING FOR CIVIL ENGINEERS | 8.88 | 11.619 | 99% |
| 2 | ENERGY CONSERVATION | 7.99 | 5.416 | 99% |
| 3 | ENGINEERING CONSTRUCTION MANAGEMENT | 7.90 | 4.572 | 99% |
| 4 | ENVIRONMENTAL RESOURCES MANAGEMENT | 7.31 | 1.616 | 90% |
| 5 | COMMUNICATIONS IN ORGANIZATIONS | 7.27 | 1.279 | 80% |
| 6 | POLLUTION CONTROL | 6.92 | 0. | 50% |
| 7 | HUMAN FACTORS IN ADMINISTRATION | 6.88 | 0. | 50% |
| 8 | ECONOMIC ANALYSIS FOR CE'S | 6.88 | 0. | 50% |
| 9 | MANAGING SMALL GROUPS IN ORGANIZATIONS | 6.81 | 0. | 50% |
| 10 | PAVEMENT DESIGN | 6.81 | 0. | 50% |
| 11 | PROJECT MANAGEMENT | 6.79 | 0. | 50% |
| 12 | SPEECH FOR MILITARY MANAGERS | 6.75 | 0. | 50% |
| 13 | LEADERSHIP THEORY AND APPLICATION | 6.69 | 0. | 50% |
| 14 | CORROSION AND CORROSION CONTROL | 6.67 | 0. | 50% |
| 15 | ORGANIZATIONAL MANAGEMENT: STRUCTURE | 6.60 | 0. | 50% |
| 16 | BUILDING ANATOMY | 6.60 | 0. | 50% |
| 17 | ELECTRICAL POWER SYSTEMS & DISTRIBUTION | 6.52 | 0. | 50% |
| 18 | WATER SUPPLY AND WASTE TREATMENT | 6.47 | 0. | 50% |
| 19 | STRUCTURAL DESIGN AND ANALYSIS | 6.46 | 0. | 50% |
| 20 | MANAGERIAL GOAL SETTING | 6.40 | 0. | 50% |
| 21 | PRINCIPLES OF AIR CONDITIONING | 6.37 | 0. | 50% |
| 22 | FACILITIES PLANNING | 6.30 | 0. | 50% |
| 23 | REPORT WRITING | 6.24 | 0. | 50% |
| 24 | PERSONNEL MANAGEMENT | 6.20 | 0. | 50% |
| 25 | FIRE PROTECTION SYSTEMS DESIGN | 6.17 | 0. | 50% |
| 26 | PRINCIPLES OF COUNSELING' | 6.16 | 0. | 50% |
| 27 | ORGANIZATIONAL MANAGEMENT: BEHAVIOR | 6.15 | 0. | 50% |

TABLE 16 CONTINUED

COURSE RANKING BY MEAN FOR THE CHIEF OF ENGINEERING-CONSTRUCTION
N =126

| RANK | COURSE NAME | MEAN($\bar{X}$) | Z | CONF |
|---|---|---|---|---|
| 28 | ARCHITECTURAL DESIGN | 6.15 | 0. | 50% |
| 29 | FINANCIAL MANAGEMENT | 5.96 | 0. | 50% |
| 30 | COMPUTER APPLICATIONS FOR ENGINEERS | 5.72 | 0. | 50% |
| 31 | LIFE CYCLE COST | 5.57 | 0. | 50% |
| 32 | ORGANIZATIONAL & INDUSTRIAL PSYCHOLOGY | 5.45 | 0. | 50% |
| 33 | MAINTENANCE MANAGEMENT | 5.28 | 0. | 50% |
| 34 | COST PLANNING AND CONTROL | 5.27 | 0. | 50% |
| 35 | HUMAN FACTORS IN AF WORK ENVIRONMENT | 5.23 | 0. | 50% |
| 36 | MANAGERIAL CONTROLS | 5.19 | 0. | 50% |
| 37 | QUALITY CONTROL | 5.16 | 0. | 50% |
| 38 | AIRPORT PLANNING AND DESIGN | 5.10 | 0. | 50% |
| 39 | AUTOMATIC CONTROL SYSTEMS | 4.99 | 0. | 50% |
| 40 | QUANT ANALYSIS FR ENGINEERING MANAGEMENT | 4.93 | 0. | 50% |
| 41 | URBAN PLANNING | 4.87 | 0. | 50% |
| 42 | INDUSTRIAL TRAINING | 4.76 | 0. | 50% |
| 43 | INDUSTRIAL SAFETY | 4.61 | 0. | 50% |
| 44 | TRANSPORTATION SYSTEMS DESIGN | 4.54 | 0. | 50% |
| 45 | FEDERAL LABOR RELATIONS MANAGEMENT | 4.48 | 0. | 50% |
| 46 | COST ACCOUNTING AND MANAGEMENT CONTROL | 4.39 | 0. | 50% |
| 47 | SYSTEMS/OPERATIONS RESEARCH | 4.23 | 0. | 50% |
| 48 | RESEARCH | 3.79 | -0.941 | 80% |
| 49 | MICRO ECONOMICS FOR DEFENSE PLANNING | 3.79 | -1.042 | 80% |
| 50 | METHODS AND STANDARDS ANALYSIS | 3.69 | -1.556 | 90% |
| 51 | PROBABILITY AND STATISTICS | 3.37 | -3.223 | 99% |
| 52 | STATISTICS II | 3.16 | -4.574 | 99% |
| 53 | DISTRIBUTION MANAGEMENT | 3.10 | -5.435 | 99% |
| 54 | PRINCIPLES OF ACCOUNTING | 2.99 | -6.187 | 99% |

TABLE 17

COURSE RANKING BY MEAN FOR THE SUM OF ALL POSITIONS

N =486

| RANK | COURSE NAME | MEAN($\bar{X}$) | Z | CONF |
|---|---|---|---|---|
| 1 | ENERGY CONSERVATION | 7.59 | 6.234 | 99% |
| 2 | HUMAN FACTORS IN ADMINISTRATION | 7.48 | 4.932 | 99% |
| 3 | CONTRACTING FOR CIVIL ENGINEERS | 7.36 | 3.261 | 99% |
| 4 | COMMUNICATIONS IN ORGANIZATIONS | 7.33 | 3.337 | 99% |
| 5 | MANAGERIAL GOAL SETTING | 7.08 | 0.756 | 70% |
| 6 | SPEECH FOR MILITARY MANAGERS | 7.05 | 0.495 | 60% |
| 7 | ENVIRONMENTAL RESOURCES MANAGEMENT | 7.00 | 0.043 | 50% |
| 8 | LEADERSHIP THEORY AND APPLICATION | 6.96 | 0. | 50% |
| 9 | FINANCIAL MANAGEMENT | 6.96 | 0. | 50% |
| 10 | ECONOMIC ANALYSIS FOR CE'S | 6.96 | 0. | 50% |
| 11 | PRINCIPLES OF COUNSELING | 6.95 | 0. | 50% |
| 12 | ORGANIZATIONAL MANAGEMENT: BEHAVIOR | 6.93 | 0. | 50% |
| 13 | MANAGING SMALL GROUPS IN ORGANIZATIONS | 6.91 | 0. | 50% |
| 14 | ORGANIZATIONAL MANAGEMENT: STRUCTURE | 6.88 | 0. | 50% |
| 15 | PERSONNEL MANAGEMENT | 6.75 | 0. | 50% |
| 16 | ORGANIZATIONAL & INDUSTRIAL PSYCHOLOGY | 6.25 | 0. | 50% |
| 17 | REPORT WRITING | 6.18 | 0. | 50% |
| 18 | MAINTENANCE MANAGEMENT | 6.09 | 0. | 50% |
| 19 | HUMAN FACTORS IN AF WORK ENVIRONMENT | 6.07 | 0. | 50% |
| 20 | MANAGERIAL CONTROLS | 6.06 | 0. | 50% |
| 21 | FEDERAL LABOR RELATIONS MANAGEMENT | 6.04 | 0. | 50% |
| 22 | POLLUTION CONTROL | 6.02 | 0. | 50% |
| 23 | ENGINEERING CONSTRUCTION MANAGEMENT | 6.01 | 0. | 50% |
| 24 | FACILITIES PLANNING | 5.89 | 0. | 50% |
| 25 | PROJECT MANAGEMENT | 5.78 | 0. | 50% |
| 26 | INDUSTRIAL SAFETY | 5.74 | 0. | 50% |
| 27 | PAVEMENT DESIGN | 5.73 | 0. | 50% |

TABLE 17 CONTINUED

COURSE RANKING BY MEAN FOR THE SUM OF ALL POSITIONS

N =486

| RANK | COURSE NAME | MEAN($\bar{X}$) | Z | CONF |
|---|---|---|---|---|
| 28 | WATER SUPPLY AND WASTE TREATMENT | 5.63 | 0. | 50% |
| 29 | COST PLANNING AND CONTROL | 5.57 | 0. | 50% |
| 30 | CORROSION AND CORROSION CONTROL | 5.55 | 0. | 50% |
| 31 | QUALITY CONTROL | 5.45 | 0. | 50% |
| 32 | ELECTRICAL POWER SYSTEMS & DISTRIBUTION | 5.45 | 0. | 50% |
| 33 | BUILDING ANATOMY | 5.44 | 0. | 50% |
| 34 | FIRE PROTECTION SYSTEMS DESIGN | 5.36 | 0. | 50% |
| 35 | COST ACCOUNTING AND MANAGEMENT CONTROL | 5.35 | 0. | 50% |
| 36 | INDUSTRIAL TRAINING | 5.33 | 0. | 50% |
| 37 | QUANT ANALYSIS FR ENGINEERING MANAGEMENT | 5.15 | 0. | 50% |
| 38 | LIFE CYCLE COST | 5.09 | 0. | 50% |
| 39 | URBAN PLANNING | 5.09 | 0. | 50% |
| 40 | PRINCIPLES OF AIR CONDITIONING | 5.05 | 0. | 50% |
| 41 | ARCHITECTURAL DESIGN | 4.94 | 0. | 50% |
| 42 | COMPUTER APPLICATIONS FOR ENGINEERS | 4.85 | 0. | 50% |
| 43 | STRUCTURAL DESIGN AND ANALYSIS | 4.72 | 0. | 50% |
| 44 | SYSTEMS/OPERATIONS RESEARCH | 4.67 | 0. | 50% |
| 45 | AIRPORT PLANNING AND DESIGN | 4.47 | 0. | 50% |
| 46 | AUTOMATIC CONTROL SYSTEMS | 4.36 | 0. | 50% |
| 47 | METHODS AND STANDARDS ANALYSIS | 4.16 | 0. | 50% |
| 48 | TRANSPORTATION SYSTEMS DESIGN | 4.14 | 0. | 50% |
| 49 | MICRO ECONOMICS FOR DEFENSE PLANNING | 3.95 | -0.484 | 60% |
| 50 | PROBABILITY AND STATISTICS | 3.77 | -2.310 | 95% |
| 51 | DISTRIBUTION MANAGEMENT | 3.74 | -2.677 | 99% |
| 52 | PRINCIPLES OF ACCOUNTING | 3.66 | -3.423 | 99% |
| 53 | RESEARCH | 3.57 | -4.190 | 99% |
| 54 | STATISTICS II | 3.31 | -7.232 | 99% |

# APPENDIX C

## RESULTS OF QUESTIONNAIRE SECTION C

## Appendix C Explanation

For the Management Position written in the title:

a. Column 1. Course Name--a listing of courses that had a mean rating greater than 7.00 from either the military, civilians or total respondents.

b. Column 2. MIL--the percentage of military respondents who have had the course.

c. Column 3. CIV--the percentage of civilian respondents who have had the course.

d. Column 4. TOT--the percentage of all respondents who have had the course.

e. NOTE: Those percentages that are enclosed within parenthesis indicate that group or subgroup of respondents that did not have a course mean rating of 7.00 or above.

TABLE 18

PERCENT OF BASE CIVIL ENGINEERS WHO HAD EACH NEEDED COURSE

| Course Name | MIL | CIV | TOT |
|---|---|---|---|
| Energy Conservation | 36.2 | 32.3 | 34.3 |
| Contracting for Civil Engineers | 47.8 | 56.9 | 52.2 |
| Human Factors in Administration | 71.0 | 67.7 | 69.4 |
| Organizational Management: Behavior | 75.4 | 76.9 | 76.1 |
| Managerial Goal Setting | 78.3 | 78.5 | 78.4 |
| Financial Management | 68.1 | 44.6 | 56.7 |
| Communications in Organizations | 68.1 | 64.6 | 66.4 |
| Speech for Military Managers | 75.4 | 44.6 | 60.4 |
| Leadership Theory and Application | 78.3 | 69.2 | 73.9 |
| Principles of Counseling | 66.7 | 38.5 | 53.0 |
| Environmental Resources Management | 26.1 | (35.4) | 30.6 |
| Organizational Management: Structure | 79.7 | (72.3) | 76.1 |
| Federal Labor Relations Management | 50.7 | 70.8 | 60.4 |
| Managing Small Groups in Organizations | 72.5 | (69.2) | (70.9) |
| Organizational & Industrial Psycnology | 53.6 | 43.1 | 48.5 |
| Economic Analysis for CEs | 59.4 | (43.1) | (51.5) |
| Managerial Controls | 60.9 | (72.3) | (66.4) |
| AVERAGE | 62.8% | 57.6% | 60.3% |

TABLE 19

PERCENT OF CHIEFS OF PROGRAMS WHO HAD EACH NEEDED COURSE

| Course Name | MIL | CIV | TOT |
|---|---|---|---|
| Financial Management | 60.9 | 54.7 | 58.2 |
| Human Factors in Administration | 65.2 | 56.6 | 61.5 |
| Communications in Organizations | 72.5 | 52.8 | 63.9 |
| Contracting for Civil Engineers | 36.2 | (37.7) | (36.9) |
| Principles of Counseling | 66.7 | (39.6) | (54.9) |
| Economic Analysis for CEs | 42.0 | (37.7) | 40.2 |
| Speech for Military Managers | 78.3 | 47.2 | 64.8 |
| Leadership Theory and Application | 81.2 | (52.8) | (68.9) |
| Managerial Goal Setting | 76.8 | (60.4) | (69.7) |
| Organizational Management: Structure | 75.4 | (56.6) | 67.2 |
| Managing Small Groups in Organizations | 76.8 | (62.3) | 70.5 |
| Personnel Management | 63.8 | (62.3) | (63.1) |
| Organizational Management: Behavior | 75.4 | (47.2) | (63.1) |
| AVERAGE | 67.0% | 51.4% | 60.2% |

TABLE 20

PERCENT OF CHIEFS OF OPERATIONS & MAINTENANCE WHO HAD EACH NEEDED COURSE

| Course Name | MIL | CIV | TOT |
|---|---|---|---|
| Industrial Safety | 35.0 | 57.1 | 43.2 |
| Energy Conservation | 30.0 | 22.9 | 27.4 |
| Human Factors in Administration | 63.3 | 42.9 | 55.8 |
| Environmental Resources Management | (15.0) | 8.6 | (12.6) |
| Organizational Management: Behavior | 66.7 | 48.6 | 60.0 |
| Managerial Goal Setting | (75.0) | 48.6 | 65.3 |
| Federal Labor Relations Management | (33.3) | 68.6 | 46.3 |
| Communications in Organizations | (71.7) | 37.1 | 58.9 |
| Principles of Counseling | 66.7 | 60.0 | 64.2 |
| Human Factors in AF Work Environment | 48.3 | 45.7 | 47.4 |
| Personnel Management | 70.0 | 65.7 | 68.4 |
| Maintenance Management | (40.0) | 54.3 | (45.3) |
| Economic Analysis for CEs | (46.7) | 20.0 | (36.8) |
| Organizational Management: Structure | 76.7 | (51.4) | (67.4) |
| Leadership Theory and Application | 80.0 | (51.4) | 69.5 |
| AVERAGE | 54.6% | 45.5% | 51.2% |

TABLE 21

PERCENT OF CHIEFS OF ENGINEERING & CONSTRUCTION WHO HAD EACH NEEDED COURSE

| Course Name | MIL | CIV | TOT |
|---|---|---|---|
| Contracting for Civil Engineers | 76.9 | 63.7 | 65.1 |
| Engineering Construction Management | 69.2 | 61.1 | 61.9 |
| Economic Analysis for CEs | 46.2 | (50.4) | (50.0) |
| Energy Conservation | 53.8 | (33.6) | (35.7) |
| Project Management | 69.2 | 45.1 | 47.6 |
| Pavement Design | 53.8 | (61.9) | (61.1) |
| Building Anatomy | 38.5 | (43.4) | (42.9) |
| Human Factors in Administration | 92.3 | (61.1) | (64.3) |
| Structural Design and Analysis | 61.5 | (81.4) | (79.4) |
| Environmental Resources Management | (53.8) | 29.2 | 31.7 |
| Communications in Organizations | (76.9) | 54.9 | 57.1 |
| AVERAGE | 62.9% | 53.3% | 54.3% |

TABLE 22

PERCENT OF TOTAL RESPONDENTS WHO HAD EACH NEEDED COURSE

| Course Name | MIL | CIV | TOT |
|---|---|---|---|
| Human Factors in Administration | 68.2 | 59.4 | 63.3 |
| Energy Conservation | 29.9 | 29.3 | 29.6 |
| Principles of Counseling | 67.3 | (47.7) | (56.4) |
| Communications in Organizations | 71.1 | 54.5 | 61.8 |
| Leadership Theory and Application | 81.0 | (57.5) | (67.9) |
| Contracting for Civil Engineers | 43.1 | 50.8 | 47.4 |
| Organizational Management: Behavior | 73.5 | (57.5) | (64.6) |
| Managerial Goal Setting | 77.7 | (67.3) | 71.9 |
| Organizational Management: Structure | 78.7 | (64.7) | (70.9) |
| Speech for Military Managers | 78.7 | (41.7) | 58.1 |
| Financial Management | 62.1 | (39.8) | (49.7) |
| Economic Analysis for CEs | 49.3 | (42.1) | (45.3) |
| Managing Small Groups in Organizations | 74.4 | (66.5) | (70.0) |
| Environmental Resources Management | (23.7) | 27.4 | 25.8 |
| AVERAGE | 62.8 | 50.4 | 55.9 |

# APPENDIX D

# SURVEY QUESTIONNAIRE

DEPARTMENT OF THE AIR FORCE
AIR FORCE INSTITUTE OF TECHNOLOGY (AU)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

REPLY TO ATTN OF: LSGM (LSSR 29-77B/Capt Gauntt/Capt Stann/AUTOVON 787-4240)

5 May 1977

SUBJECT: Base Level Civil Engineering Educational Needs

TO:

1. The attached questionnaires were prepared by a research team at the Air Force Institute of Technology, Wright-Patterson AFB, Ohio. The purpose of the questionnaire is to help determine which subject areas are most useful to base level management positions in Air Force Civil Engineering.

2. You are requested to complete the questionnaire and in addition you are requested to ask your deputy or the individual, military or civilian, who acts as branch chief in your absence, to complete the survey. An extra copy of the questionnaire is included for this purpose. Headquarters USAF Survey Control Number 77-95 has been assigned to this questionnaire. Participation in this research is voluntary. If either of you elect not to participate, please return the unanswered questionnaire and the answer sheet in the envelopes provided.

3. Responses to the questionnaire will be held confidential. You need return only the completed answer sheet but if you wish to make any comments also include the last page of the questionnaire which has space for your comments. Your cooperation in providing this data will be appreciated and will be beneficial in evaluating the educational needs of base level civil engineering managers. Please return the answer sheet with or without comments within one week after receipt.

Henry W. Parlett

HENRY W. PARLETT, Colonel, USAF
Associate Dean for Graduate Education
School of Systems and Logistics

3 Atch
1. Questionnaire (2)
2. Answer Sheet (2)
3. Return Envelope (2)

## PRIVACY STATEMENT

In accordance with paragraph 30, AFR 12-35, the following information is provided as required by the Privacy Act of 1974:

a. Authority:

(1) 5. U.S.C. 301, Departmental Regulations; and/or

(2) 10 U.S.C. 8012, Secretary of the Air Force, Powers, Duties, Delegation by Compensation; and/or

(3) DOD Instruction 1100.13, 17 Apr 68, Surveys of Department of Defense Personnel; and/or

(4) AFR 30-23, 22 Sep 76, Air Force Personnel Survey Program.

b. Principal purposes. The survey is being conducted to collect information to be used in research aimed at illuminating and providing inputs to the solution of problems of interest to the Air Force and/or DOD.

c. Routine Uses. The survey data will be converted to information for use in research of management related problems. Results of the research, based on the data provided, will be included in written master's theses and may also be included in published articles, reports, or texts. Distribution of the results of the research, based on the survey data, whether in written form or presented orally, will be unlimited.

d. Participation in this survey is entirely voluntary.

e. No adverse action of any kind may be taken against any individual who elects not to participate in any or all of this survey.

CIVIL ENGINEERING EDUCATIONAL QUESTIONNAIRE

FOR

BASE CIVIL ENGINEERING POSITION

This questionnaire has been developed to determine the educational needs and subject areas most useful to base level civil engineering managers in the Air Force. The information gathered by this questionnaire will be used by two civil engineering students at the Air Force Institute of Technology in their thesis research. Participation is voluntary and all responses will be held confidential. If you elect not to participate, please return the questionnaire and the answer sheet in the envelope provided.

Please answer this questionnaire with the duties of the Base Civil Engineer in mind. There are three sections to this questionnaire, and all answers should be marked on the answer sheets provided, and please mark only one response per question. To insure anonymous responses, do not fill in the block for SSAN. Space for additional comments has been provided on page 16. When you have completed the questionnaire, please return the answer sheet (and comments page if used) in the pre-addressed envelope provided.

Section A: Background Information

1. Which item below best describes your present duty position?

   a. Base Civil Engineer
   b. Deputy Base Civil Engineer
   c. Other

2. What is your present rank or GS grade?

   a. 0-6
   b. 0-5
   c. 0-4
   d. 0-3
   e. 0-2
   f. 0-1
   g. Other, military
   h. GS-14 or more
   i. GS-13
   j. GS-12
   k. GS-11
   l. GS-10
   m. GS-09
   n. GS-08
   o. GS-07
   p. Other, civilian



USAF SCN 77-95 (Expires 30 September 1977)

CIVIL ENGINEERING EDUCATIONAL QUESTIONNAIRE

FOR

CHIEF OF O&M POSITION

This questionnaire has been developed to determine the educational needs and subject areas most useful to base level civil engineering managers in the Air Force. The information gathered by this questionnaire will be used by two civil engineering students at the Air Force Institute of Technology in their thesis research. Participation is voluntary and all responses will be held confidential. If you elect not to participate, please return the questionnaire and the answer sheet in the envelope provided.

Please answer this questionnaire with the duties of the Chief of O&M in mind. There are three sections to this questionnaire, and all answers should be marked on the answer sheets provided, and please mark only one response per question. To insure anonymous responses, do not fill in the block for SSAN. Space for additional comments has been provided on page 16. When you have completed the questionnaire, please return the answer sheet (and comments page if used) in the pre-addressed envelope provided.

Section A: Background Information

1. Which item below best describes your present duty position?

   a-c. Do not use these answer spaces
   d. Chief of O&M
   e. Worked in O&M Branch more than one year
   f. Worked in O&M Branch less than one year

2. What is your present rank or GS grade?

| | | | |
|---|---|---|---|
| a. | 0-6 | h. | GS-14 or more |
| b. | 0-5 | i. | GS-13 |
| c. | 0-4 | j. | GS-12 |
| d. | 0-3 | k. | GS-11 |
| e. | 0-2 | l. | GS-10 |
| f. | 0-1 | m. | GS-09 |
| g. | Other, military | n. | GS-08 |
| | | o. | GS-07 |
| | | p. | Other, civilian |



USAF SCN 77-95 (Expires 30 September 1977)

CIVIL ENGINEERING EDUCATIONAL QUESTIONNAIRE

FOR

CHIEF OF PROGRAMS POSITION

This questionnaire has been developed to determine the educational needs and subject areas most useful to base level civil engineering managers in the Air Force. The information gathered by this questionnaire will be used by two civil engineering students at the Air Force Institute of Technology in their thesis research. Participation is voluntary and all responses will be held confidential. If you elect not to participate, please return the questionnaire and the answer sheet in the envelope provided.

Please answer this questionnaire with the duties of the Chief of Programs in mind. There are three sections to this questionnaire, and all answers should be marked on the answer sheets provided, and please mark only one response per question. To insure anonymous responses, do not fill in the block for SSAN. Space for additional comments has been provided on page 16. When you have completed the questionnaire, please return the answer sheet (and comments page if used) in the pre-addressed envelope provided.

Section A: Background Information

1. Which item below best describes your present duty position?

   a-f. Do not use these answer spaces
   g. Chief of Programs
   h. Worked in Programs Branch more than one year
   i. Worked in Programs Branch less than one year

2. What is your present rank or GS grade?

| | | | |
|---|---|---|---|
| a. | 0-6 | h. | GS-14 or more |
| b. | 0-5 | i. | GS-13 |
| c. | 0-4 | j. | GS-12 |
| d. | 0-3 | k. | GS-11 |
| e. | 0-2 | l. | GS-10 |
| f. | 0-1 | m. | GS-09 |
| g. | Other, military | n. | GS-08 |
| | | o. | GS-07 |
| | | p. | Other, civilian |



USAF SCN 77-95 (Expires 30 September 1977)

CIVIL ENGINEERING EDUCATIONAL QUESTIONNAIRE

FOR

CHIEF OF ENGINEERING/CONSTRUCTION POSITION

This questionnaire has been developed to determine the educational needs and subject areas most useful to base level civil engineering managers in the Air Force. The information gathered by this questionnaire will be used by two civil engineering students at the Air Force Institute of Technology in their thesis research. Participation is voluntary and all responses will be held confidential. If you elect not to participate, please return the questionnaire and the answer sheet in the envelope provided.

Please answer this questionnaire with the duties of the Chief of Engineering/Construction in mind. There are three sections to this questionnaire, and all answers should be marked on the answer sheets provided, and please mark only one response per question. To insure anonymous responses, do not fill in the block for SSAN. Space for additional comments has been provided on page 16. When you have completed the questionnaire, please return the answer sheet (and comments page if used) in the pre-addressed envelope provided.

Section A: Background Information

1. Which item below best describes your present duty position?

   a-i. Do not use these answer spaces
   j. Chief of Engineering and Construction
   k. Worked in E&C Branch more than one year
   l. Worked in E&C Branch less than one year

2. What is your present rank or GS grade?

   a. 0-6
   b. 0-5
   c. 0-4
   d. 0-3
   e. 0-2
   f. 0-1
   g. Other, military
   h. GS-14 or more
   i. GS-13
   j. GS-12
   k. GS-11
   l. GS-10
   m. GS-09
   n. GS-08
   o. GS-07
   p. Other, civilian



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3. How long have you worked in the CE career field?

a. 0-6 months
b. 6-12 months
c. 12-18 months
d. 18-24 months
e. 2-4 years
f. 4-8 years
g. 8-12 years
h. 12-16 years
i. 16-20 years
j. 20-24 years
k. More than 24 years

4. What is your highest educational level?

a. Have not completed high school or equivalent
b. High school or equivalent only
c. High school but less than two years of college
d. Associate degree or more than two years of college
e. Have a BS/BA degree
f. BS/BA degree plus some Master's level work
g. Master's degree
h. Master's degree plus
i. Ph.D.
j. Other

5. What level of education do you feel is appropriate for the Chief of the branch/office referred to on page one?

a. No degree required
b. Associate degree
c. Bachelor of Arts (BA)
d. Bachelor of Science (BS)
e. Master of Arts (MA) or Master of Business Administration (MBA)
f. Master of Science (MS)
g. Doctoral (Ph.D.)

6. What type of academic discipline do you feel is desired or necessary for the Chief of the branch/office referred to on page one?

a. Civil Engineering
b. Mechanical Engineering
c. Electrical Engineering
d. Architecture/Architectural Engineering
e. Environmental Engineering
f. Facilities Management
g. Engineering Management
h. General Engineering
i. No specific discipline is desired or necessary
j. Other, please specify on Comments Page

The following responses apply to questions 7 and 8. From the list below please indicate the two most important things you feel Civil Engineering will be concerned with in the future (limit to next 5 years).

a. Most Civil Engineering Sections will be going contract in the future.

b. Civil Engineering and Services will be combined at the Base Level.

c. Communication between the branches in Civil Engineering needs to be improved.

d. Environmental programs at the Base Level need to be improved.

e. Services is an integral part of the Civil Engineering function.

f. Civil Engineering's primary responsibility will be to plan, build, and maintain Air Force facilities.

g. Civil Engineering's primary responsibility will be to provide the best possible environment in terms of base livability.

7. From the list above, what is the most important thing Civil Engineering will be concerned with in the near future?

8. From the list above, what is the second most important thing Civil Engineering will be concerned with in the near future?

Section B: Educational Study Areas

This section asks you to rate the usefulness of the following fifty-four subject areas. The rating should be based on the relative usefulness of the course in helping an individual perform the job listed on page one. There are ten points on the rating scale with response (a) indicating an area that is never needed and response (j) indicating an area that is mandatory, and if you feel the subject would rank as a 7 on the ten-point scale, then mark response (g); if the subject only ranks as a 2, then mark response (b).

| | | |
|---|---|---|
| Never Needed: | 1--2--3--4--5--6--7--8--9--10 | :Mandatory |
| Response: | a b c d e f g h i j | :Response |

There is a scale repeated on the comments page which may be unfolded and used as a reference as you complete this section.

9. Economic Analysis for Civil Engineers

This course provides the student with an opportunity to integrate civil engineering technology with managerial analysis techniques. The course work addresses typical management decision problems encountered in the day-to-day administration of civil engineering activities. Students use economic analysis techniques combined with DOD and AF publications to solve typical civil engineering problems.

10. Report Writing

A study of the nature and use of business reports. Time is spent in the writing of analytical, informational, and research reports.

11. Quantitative Analysis for Engineering and Management

This course is concerned with problems facing modern managers and the quantitative techniques available for resolving them. This includes probability theory, break even analysis, vectors, determinants, linear programming, managerial decision making under uncertainty plus other techniques available.

12. Human Factors in Administration

This course is an investigation of the problems related to the proper use of human resources in business. Analysis is made of current trends in personnel practices and administrative human relations.

13. Architectural Design

Elementary composition, architectural problems and presentation methods for building and landscape design. Emphasis on solution of complex building programs and site planning.

14. Human Factors in the (Air Force) Work Environment

A study of human factors in the (Air Force) work environment including safety considerations as defined by OSHA. Materials handling, lifting, capacity, back injuries, body stresses and human senses are evaluated to determine how the body adapts and interacts with the work environment. Particular attention is paid to visual, audio, and temperature requirements of work areas; warehouses, offices, and outside areas.

15. Pavement Design

Introduction to pavement design and materials utilized in street, highway, and runway construction. Specifications, material testing, methods, and soil stabilizers used for subgrades, bases, and surfaces are studied with practical examples included.

16. DOD Financial Management

Emphasis is on the processes and constraints of resource management decisions within the DOD Resource Management System. Areas of study include manpower utilization, overhead cost distribution, service center operations, industrial funding, planning-programming-budgeting, output measurement, and performance control. Emphasis will be on developing the ability to analyze information presented and devise acceptable courses of action.

17. Urban Planning

Introduction to urban planning problems and analysis of legal and administrative aspects of the regulation of land use and development. Techniques of urban planning, zoning, controls, public acquisition of land, tax controls and urban redevelopment studied.

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18. Principles of Accounting

Basic principles and procedures are covered through proprietorships, partnerships and corporations. Each item of the balance sheet is critically analyzed and the income statement is considered from the point of view of matching expenses with revenues. Alternative methods and procedures are evaluated.

19. Industrial Safety

This course covers the history of accident prevention, safety councils and plant safety organizations, causes of accidents, job analysis, evaluating safety performance, plant housekeeping, maintenance and how to lay out a safe work area.

20. Probability and Statistics

Topics covered include descriptive statistics, frequency distributions, measures of control tendency, and measures of dispersion. Probability theory includes laws of probability, random variables, and probability distributions. Problems involving uncertainty are examined and hypothesis tests and confidence intervals are covered.

21. Industrial Training

A study of the psychology of industrial training and of the steps necessary to the establishment and operation of a training program. Students lead conferences and participate in other training situations utilizing various aids for more effective training of employees and management.

22. Principles of Counseling

An investigation is made into the concepts common to major counseling approaches and the helping relationships in a variety of settings including work. It also reviews some of the differences among contemporary counseling theories.

23. Transportation-Systems Design

Planning of transportation facilities, mathematical models for prediction of traffic flow, assignment and interrelationship of land use. Traffic flow phenomena, description of traffic arrival, merging movements and simulation of traffic flow processes and applications to improve capacity and safety of flow.

24. Managing Small Groups in Organizations

Role playing cases, lectures and problems are used to improve the management of small task-oriented groups. The influence of cliques, committees, conference groups, task forces and similar groups are discussed and demonstrated. The overall emphasis is on getting results from these groups.

25. Contemporary Leadership Theory and Application

Emphasis is placed on the description and evaluation of contemporary leadership theories and their historical basis. No one theory is emphasized, rather the participant is encouraged to define his own style by evaluating the contemporary theories and his own ideas and realizing that there is no one best way to lead.

26. Organization Management: Structure

A broad spectrum of organization theory, management thought, and organization/management research is covered. The course content emphasizes concepts and theories of management and focuses on their usefulness to managers. Several organizational processes are covered which include: managerial decision making, planning, and organizational control.

27. Management Controls

This course covers the various techniques and procedures available to management for planning control of the operations of an industrial enterprise. The forecasting, budgeting and controlling of operating expenses, inventories and production are studied. Other subjects covered are cost-profit-volume analysis, value analysis, contribution analysis, gross profit analysis, economic lot size calculations and graphic presentation of cost data.

28. Structural Design and Analysis

Analysis of stress, strain, fatigue, bending, torsion, warping and failure in various construction materials including concrete, steel, and timber. Approximation methods and empirical formulas are used in practical applications.

29. Contracting for Civil Engineers

This course provides education in the application of technical, legal, and management principals of preparing and managing military service and construction project contracts. Areas covered during the course include use of the Armed Services Procurement Regulations (ASPRs), contract law, procurement/civil engineering interface, specifications, and contract inspections.

30. Research Techniques

This course is designed to present basic theory, philosophy, techniques and styles of management research and research report writing. The major product of this course is a formal written research proposal.

31. Managerial Goal Setting

The course establishes a basis for implementing the DOD Management by Objectives Program (MBO) in lower organizational levels for objective performance appraisal, managerial planning and control, training and developing subordinates, and increasing the degree of participation in management of the organization's resources for mission accomplishment.

32. Computer Applications for Engineers

Introduction to computer systems; FORTRAN programming and applications to common engineering problems including architectural, construction, estimating and management. Laboratory problems provide practice in programming various selected problems.

33. Electrical Power Systems and Distribution

Basic electrical power systems are studied with emphasis on power generation and distribution. Power system economics and emergency power distribution systems are included.

34. Micro Economic Analysis for Defense Planning

This course provides the student with the ability to apply basic techniques of economic analysis to defense management problems. Emphasis is on solving problems of resource allocation and resolve the problems through marginal analysis, mathematical programming, and present value analysis.

35. Personnel Management

A comparison and evaluation of public and private personnel practices and techniques of recruiting, selecting, transferring, promoting, classifying, training and compensating workers.

36. Engineering Project Management

Organization theory and the project manager as a leader. Scientific principles and application arts for computer-compatible management in project definition, design, implementation, and evaluation. Formulations including environmental, industrial, business, and administrative challenges with people influences.

37. Quality Control

This course is designed to provide the student with an understanding of quality, how it is measured, and how it can be improved. Statistical quality control programs are examined and practical applications are discussed showing how quality control helps provide timely quantitative data in many areas of endeavor.

38. Federal Labor Relations Management

The major objective of this course is to acquaint the student with the collective-bargaining process. The course will discuss the principal phases of the collective-bargaining process, the problems associated with each phase, and their impact on the DOD manager. Relevant executive orders and federal legislation will be discussed with their impact on personal management responsibilities.

39. Pollution Control: Air, Noise

Study of pollution control systems and techniques, including acoustics and problem areas and noise legislation. Practical concepts in design, construction, measurement and analysis of noise suppression techniques, including industrial, commercial and community air pollution problems.

40. Organization Management: Behavior

Topics covered include the nature and importance of the individual-organization relationship, basic social-psychological processes that affect individual and group behavior, influences on work behavior and their impact on performance and satisfaction, and minority problems in the work environment. The nature and roles of unions in the federal sector are covered.

41. Systems Analysis/Operations Research

This course is designed to provide the student with a foundation in the basic techniques, methods and principles of Operations Research for management decision making, network theory and its application to logistics, facilities and procurement. Other topics discussed are decision making under conditions of certainty, risk and uncertainty and the applications of Operations Research in the defense environment.

42. Organizational and Industrial Psychology

This course deals with the elements of change in an organization and its functional and dysfunctional effects on the individual, groups in the organization, and the organization as a whole. Attention is given to leadership and supervision, conflict, communications, and the organization as a social system. Special emphasis is given to organizational development and the latest developments in this area such as job enrichment, overlapping group structures, motivation, etc.

43. Statistics: Advanced

This is a continuation of basic statistics and probability with emphasis on applied statistics, and problem solving. The estimation of functional relationships using the regression model is presented and the generality of the regression model is emphasized by considering various nonlinear forms. An introduction to the analysis of variance model is given and other nonparametric techniques are covered to illustrate their usefulness.

44. Corrosion and Corrosion Control

The electrochemical theory of corrosion, recommended materials and protective measures for chemical processing equipment and for atmospheric, underground, underwater, and elevated temperature exposures.

45. Water Supply and Waste Treatment

Water resources and biological bases of pollution and degradation. Potability and chemical aspects of quality control and reclamation. Evaluation of industrial waste problems, character and quantity of wastes produced from various industrial activities, and application of engineering principles to treatment and disposal techniques.

46. Life Cycle Cost

This course explores the concepts and methodologies which should be considered in the development of life cycle cost models. Several LCC models currently in use are discussed along with their deficiencies, and how some of the deficiencies may be overcome.

47. Methods and Standards Analysis

This course includes the study and fundamentals of process and organization analysis, time and motion study, work sampling, work simplification, fatigue, operation standards, and industrial efficiency as a whole.

48. Cost Planning and Control

This course focuses on the development, organization, tools, techniques and management of cost reduction programs. Students examine many of the concepts used by managers in cost reduction such as work standardization, employee motivation programs, value engineering, defining elements of cost and reporting savings to higher management.

49. Airport Planning and Design

Airport site selection, runway length and orientation, traffic control, drainage and lighting, long-range planning, government responsibility for air traffic control and transportation.

50. Maintenance Management

This course provides a framework for the application of production management and control concepts to the management of maintenance activities within the USAF. An analysis of DOD and AF policy for equipment maintenance and design concepts concerning products, layouts, and jobs are discussed followed by problems utilizing PERT, correlation and regression, and other statistical analysis techniques.

51. Facilities Planning

Special problems are investigated in the use and modification of social and environmental facilities in urban and metropolitan areas. Schools, hospitals, airports, office buildings, utility plants, warehouses, and factories are examined. Support subsystems and work environment are studied.

52. Energy Conservation

Energy conservation covers procedures for reducing energy consumption in various systems: electrical, gas, coal, fuel oils. Applications of new procedures to include investigation of solar energy, geothermal, and water power.

53. Environmental Planning and Resources Management

Important aspects of the Environmental Policy Act (EPA), Occupational Safety and Health Act (OSHA), and the energy crisis are discussed and how they impact on DOD daily operations. The many facets of pollution and pollution control are discussed including special topics such as land use, ecology, environmental assessments, environmental protection and EPA regulations affecting Air Force operations.

54. Cost Accounting and Managerial Control

Emphasis is placed on the basic theory and procedures involving materials, labor, and manufacturing expenses in job order and process cost systems. Standard costs are comprehensively treated with emphasis on cost control and product costing and study of the uses of accounting data by management in decision making and managerial control.

55. Automatic Control Systems

Analysis and modeling of linear systems and compensation of feedback controlled systems using classical methods. Hydraulic, pneumatic, thermal, electrical, nuclear, chemical, and biomechanical systems examined.

56. Fire Protection Systems Design

Interrelationships of construction, occupancy, exposure, and protection. Flammable liquids, gases, combustible solids, dusts, chemicals, and explosives with emphasis on their industrial applications and fire hazard involved.

57. Building Anatomy

Introduction to building frames, components, and construction techniques, requirements and design of climate control systems, sound and lighting control. Design of structural systems for building, analysis of architectural requirements for facilities, comparison of simple structural systems.

58. Distribution Management

This course examines and compares logistics and distribution theories applicable in both civilian and military environments. Study of specific subfunctions such as inventory, transportation, warehousing, plant location, material movement, and communication are included.

59. Speech for Military Managers

This course is designed to improve the student's ability to address an audience in a well-organized speech, delivered in simple, direct, and meaningful language. Particular attention is paid to the organization and structure of a speech supporting ideas in a clear, logical manner. Several speeches will be prepared and delivered by each student.

60. Engineering Construction Management

Development of modern engineering construction management concepts is presented followed by practical application examples particularly in the multi-functional organization. Course includes computer applications to program development and various management techniques.

61. Communications in Organizations

This course is designed to develop a communication perspective and knowledge of the impact of communication on the performance of both defense and other organizations. The student will be better able to assess his own and other's communication, both oral and written, and he will be better able to make improvements in his communication.

62. Principles of Air Conditioning

Psychometric principles. Thermal comfort. Load estimates. Environmental control. System design using load wedge and supply area concepts. Experiments to determine components and system performance. Design of transportation and delivery systems and energy recovery schemes. Total energy concepts.

Section C

We are also interested in whether or not you have had a course in any of the previously described subject areas and where or how you completed the course. This section lists each subject area individually and asks where or how you completed the course or a similar course. Use the following format to provide answers, and provide only one response per question.

a. Have not had a similar course.
b. Undergraduate (BS/BA) - in residence
c. Undergraduate (BS/BA) - correspondence
d. Graduate level (MS/MA) - in residence
e. Graduate level (MS/MA) - correspondence
f. PME (SOS, ACSC, etc.)
g. Continuing Education (AFIT Civil Engineering School, Base Management Course, Off-Duty Refresher course, etc.)
h. Doctoral Program (Ph.D.)

63. Economic Analysis for CE's
64. Report Writing
65. Quantitative Analysis for Engineering and Management
66. Human Factors in Administration
67. Architectural Design
68. Human Factors in Air Force Work Environment
69. Pavement Design
70. Financial Management
71. Urban Planning
72. Principles of Accounting
73. Industrial Safety
74. Probability and Statistics
75. Industrial Training
76. Principles of Counseling
77. Transportation Systems Design
78. Managing Small Groups in Organizations
79. Contemporary Leadership Theory and Application
80. Organizational Management Structure
81. Management Controls
82. Structural Design and Analysis
83. Contracting for Civil Engineers
84. Research Techniques
85. Managerial Goal Setting
86. Computer Applications for Engineers
87. Electrical Power Systems and Distribution
88. Micro Economic Analysis for Defense Planning
89. Personnel Management
90. Engineering Project Management
91. Quality Control
92. Federal Labor Relations Management

93. Pollution Control
94. Organizational Management Behavior
95. Systems Analysis/Operations Research
96. Organizational and Industrial Psychology
97. Statistics: Advanced
98. Corrosion and Corrosion Control
99. Water Supply and Waste Treatment
100. Life Cycle Cost
101. Methods and Standards Analysis
102. Cost Planning and Control
103. Airport Planning and Design
104. Maintenance Management
105. Facilities Planning
106. Energy Conservation
107. Environmental Planning and Resources Management
108. Cost Accounting and Managerial Control
109. Automatic Control Systems
110. Fire Protection Systems Design
111. Building Anatomy
112. Distribution Management
113. Speech for Military Managers
114. Engineering Construction Management
115. Communications in Organizations
116. Principles of Air Conditioning

COMMENTS PAGE

1. Please fill in the six-digit coded number in the upper right corner of your answer sheet. ☐☐☐☐☐☐

2. Please indicate the degree you feel is appropriate for the Chief of the branch you work in if you checked other in question six.

3. Additional courses you feel are important.

   a. _____

   b. _____

   c. _____

   d. _____

4. Any additional comments such as: Do you feel this survey will be useful? How important do you feel this type if information is? (Use the back if necessary).

Never Needed: 1--2--3--4--5--6--7--8--9--10 :Mandatory

Response: a b c d e f g h i j :Response

# APPENDIX E

# COMPUTER PROGRAM

```
0010C CIVIL ENGINEER QUESTIONNAIRE ANALYSIS PROGRAM
0020C JOHN F STANN JR  AND  WILLIAM A GAUNTT
0030C
0040 DIMENSION SUMM(57,8),XDAT(54),RKMN(54,5),CRMN(54,5),
0050 &Z(54,5),N(55,5),ZTMP(54),TEMP(5),SMSO(55),STER(54,5),
0060 &F(54),S(54,5)
0070 CHARACTER NAME*40(54)
0080 CHARACTER TNME*40(54)
0090 CHARACTER SRME*40
0100 CHARACTER FALF*3(54)
0110 CHARACTER ZALF*3(54,5)
0120 CHARACTER TALF*3(54)
0130 CHARACTER SALF*3
0140 CHARACTER DATA*1(54)
0150 CHARACTER  JOB*1
0160C
0170C CALLING UP DATA FILES
0180C
0190 CALL FPARAM(1,118)
0200 CALL ATTACH(10,"77B75/DATATHS2;",1,0,,)
0210 CALL ATTACH(11,"77B79/COURSES2;",1,0,,)
0220 CALL ATTACH(12,"77B79/THESCODE;",1,0,,)
0230C
0240C QUESTIONNAIRE FORMAT STATEMENTS
0250C
0260 200 FORMAT(4X,A40)
0270 201 FORMAT(6X,A1,7X,54(A1))
0280 202 FORMAT(35X,"COURSE RANKING BY MEAN FOR THE",
0290 &" BASE CIVIL ENGINEER")
0300 204 FORMAT(36X,"COURSE RANKING BY MEAN FOR THE",
0310 &" CHIEF OF PROGRAMS")
0320 203 FORMAT(28X,"COURSE RANKING BY MEAN FOR THE",
0330 &" CHIEF OF OPERATIONS & MAINTENANCE")
0340 205 FORMAT(29X,"COURSE RANKING BY MEAN FOR THE",
0350 &" CHIEF OF ENGINEERING-CONSTRUCTION")
0360 206 FORMAT(33X,"COURSE RANKING BY X FOR THE",
0370 &" SUM OF ALL POSITIONS")
0380 207 FORMAT(57X,"N =",I3,10X," ")
0390 208 FORMAT(21X,"RANK",13X,"COURSE NAME",19X,"MEAN(X)",
0400 &10X,"Z",9X,"CONF")
0410 209 FORMAT(4X,":",16X,78("-"),16X,":")
0420 210 FORMAT(22X,I2,1X,A40,3X,F6.2,8X,F7.3,7X,A3)
0430 217 FORMAT(4X,2(F4.2,1X))
0440 218 FORMAT(/)
0450 219 FORMAT(/)
0460 220 FORMAT(/)
0470 221 FORMAT(/)
0480 222 FORMAT(/)
0490 223 FORMAT(5(/))
0500 224 FORMAT(6(/))
```

```
0510 225 FORMAT(14(/))
0520 226 FORMAT(4X,":...",50X,"....",50X,"...:")
0530 227 FORMAT(56X,"TABLE",2X,I2)
0540 228 FORMAT(50X,"TABLE",2X,I2,3X,"CONTINUED")
0550C
0560C INPUT CODING VALUES
0570C
0580 READ(12,217)CX,CY
0590C
0600C INPUT OF COURSE NAMES
0610C
0620 DO 300 IA=1,54
0630 READ(11,200,END=21)NAME(IA)
0640 300 CONTINUE
0650C
0660C INPUT RESPONSE DATA
0670C
0680 21 READ(10,201,END=23)JOB,(DATA(IE),IE=1,54)
0690 IF(JOB.EQ.'A')GO TO 530
0700 IF(JOB.EQ.'B')GO TO 530
0710 IF(JOB.EQ.'D')GO TO 531
0720 IF(JOB.EQ.'E')GO TO 531
0730 IF(JOB.EQ.'G')GO TO 532
0740 IF(JOB.EQ.'H')GO TO 532
0750 IF(JOB.EQ.'J')GO TO 533
0760 IF(JOB.EQ.'K')GO TO 533
0770 GO TO 21
0780 530 IB=1
0790 GO TO 534
0800 531 IB=2
0810 GO TO 534
0820 532 IB=3
0830 GO TO 534
0840 533 IB=4
0850 534 DO 400 JS=1,54
0860 XDAT(JS)=5.5
0870 IF(DATA(JS).EQ.'A') XDAT(JS)=1
0880 IF(DATA(JS).EQ.'B') XDAT(JS)=2
0890 IF(DATA(JS).EQ.'C') XDAT(JS)=3
0900 IF(DATA(JS).EQ.'D') XDAT(JS)=4
0910 IF(DATA(JS).EQ.'E') XDAT(JS)=5
0920 IF(DATA(JS).EQ.'F') XDAT(JS)=6
0930 IF(DATA(JS).EQ.'G') XDAT(JS)=7
0940 IF(DATA(JS).EQ.'H') XDAT(JS)=8
0950 IF(DATA(JS).EQ.'I') XDAT(JS)=9
0960 IF(DATA(JS).EQ.'J') XDAT(JS)=10
0970 400 CONTINUE
0980 IF(JOHN.EQ.999) GO TO 535
0990 DO 303 IJ=1,54
1000 N(IJ,IB)=N(IJ,IB)+1
```

```
1010 N(55,5)=N(55,5)+1
1020 N(IJ,5)=N(IJ,5)+1
1030 N(55,IB)=N(55,IB)+1
1040 SUMM(IJ,IB)=SUMM(IJ,IB)+XDAT(IJ)
1050 SUMM(IJ,5)=SUMM(IJ,5)+XDAT(IJ)
1060 SUMM(55,IB)=SUMM(55,IB)+XDAT(IJ)
1070 SUMM(55,5)=SUMM(55,5)+XDAT(IJ)
1080 SMSQ(IJ)=SMSQ(IJ)+XDAT(IJ)**2
1090 SMSQ(55)=SMSQ(55)+XDAT(IJ)**2
1100 303 CONTINUE
1110 GO TO 21
1120 23 REWIND 10
1130 IF(JOHN.EQ.999) GO TO 80
1140 DO 301 IL=1,54
1150 SUMM(IL,6)=SUMM(IL,5)**2
1160 SUMM(IL,7)=SUMM(IL,5)/N(IL,5)
1170 SUMM(55,6)=SUMM(55,6)+SUMM(IL,5)**2
1180 DO 310 IV=1,5
1190 CRMN(IL,IV)=SUMM(IL,IV)/N(IL,IV)
1200 310 CONTINUE
1210 301 CONTINUE
1220 DO 311 IW=1,4
1230 SUMM(56,IW)=SUMM(55,IW)**2
1240 SUMM(56,5)=SUMM(56,5)+SUMM(55,IW)**2
1250 SUMM(57,IW)=SUMM(55,IW)/N(55,IW)
1260 311 CONTINUE
1270C
1280C CALCULATE THE COURSE STANDARD ERROR OF THE MEAN
1290C
1300 535 JOHN=999
1310 DO 360 JK=1,54
1320 S(JK,IB)=S(JK,IB)+(XDAT(JK)-CRMN(JK,IB))**2
1330 S(JK,5)=S(JK,5)+(XDAT(JK)-CRMN(JK,5))**2
1340 360 CONTINUE
1350 GO TO 21
1360 80 DO 361 JL=1,5
1370 DO 304 JM=1,54
1380 STER(JM,JL)=(S(JM,JL)/(N(JM,JL)*(N(JM,JL)-1)))**0.5
1390C
1400C CALCULATIONS FOR THE "Z̄" STATISTICS
1410C
1420 IF(CRMN(JM,JL).GT.CY) GO TO 35
1430 IF(CRMN(JM,JL).LT.CX) GO TO 34
1440 GO TO 33
1450 34 IF(STER(JM,JL).LE.0) GO TO 32
1460 Z̄(JM,JL)=(CRMN(JM,JL)-CX)/STER(JM,JL)
1470 IF(Z(JM,JL).LT.-99.999) GO TO 32
1480 GO TO 31
1490 35 IF(STER(JM,JL).LE.0) GO TO 30
1500 Z̄(JM,JL)=(CRMN(JM,JL)-CY)/STER(JM,JL)
```

```
1510 IF(Z(JM,JL).GT.99.999) GO TO 33
1520 GO TO 31
1530 33 Z(JM,JL)=0
1540 GO TO 31
1550 39 Z(JM,JL)=99.999
1560 GO TO 31
1570 32 Z(JM,JL)=-99.999
1580C
1590C DETERMINE THE CONFIDENCE OF Z
1600C
1610  31 ZA=Z(JM,JL)
1620 IF(ZA.GT.0) GO TO 36
1630 IF(ZA.LT.0) GO TO 37
1640 44 ZALF(JM,JL)="50%"
1650 GO TO 304
1660 36 IF(ZA.GE.2.33) GO TO 38
1670 IF(ZA.GE.1.64) GO TO 39
1680 IF(ZA.GE.1.28) GO TO 40
1690 IF(ZA.GE.0.84) GO TO 41
1700 IF(ZA.GE.0.52) GO TO 42
1710 IF(ZA.GE.0.25) GO TO 43
1720 GO TO 44
1730 37 IF(ZA.LE.-2.33) GO TO 38
1740 IF(ZA.LE.-1.64) GO TO 39
1750 IF(ZA.LE.-1.28) GO TO 40
1760 IF(ZA.LE.-0.84) GO TO 41
1770 IF(ZA.LE.-0.52) GO TO 42
1780 IF(ZA.LE.-0.25) GO TO 43
1790 38 ZALF(JM,JL)="99%"
1800 GO TO 304
1810 39 ZALF(JM,JL)="95%"
1820 GO TO 304
1830 40 ZALF(JM,JL)="90%"
1840 GO TO 304
1850 41 ZALF(JM,JL)="80%"
1860 GO TO 304
1870 42 ZALF(JM,JL)="70%"
1880 GO TO 304
1890 43 ZALF(JM,JL)="60%"
1900 304 CONTINUE
1910 361 CONTINUE
1920C
1930C SORTING COURSES BY X FROM HIGH TO LOW
1940C
1950 PRINT 224
1960 DO 350 JC=1,5
1970 DO 305 IM=1,54
1980 ZTMP(IM)=Z(IM,JC)
1990 RKMN(IM,JC)=CRMN(IM,JC)
2000 TNME(IM)=NAME(IM)
```

```
2010 TALF(IM)=ZALF(IM,JG)
2020 305 CONTINUE
2030 DO 306 IN=1,53
2040 IO=IN+1
2050 DO 306 IP=IO,54
2060 IF(RKMN(IN,JG).GT.RKMN(IP,JG)) GO TO 306
2070 STOR=ZTMP(IN)
2080 TEMP(JG)=RKMN(IN,JG)
2090 SRME=TNME(IN)
2100 SALF=TALF(IN)
2110 ZTMP(IN)=ZTMP(IP)
2120 RKMN(IN,JG)=RKMN(IP,JG)
2130 TNME(IN)=TNME(IP)
2140 TALF(IN)=TALF(IP)
2150 ZTMP(IP)=STOR
2160 RKMN(IP,JG)=TEMP(JG)
2170 TNME(IP)=SRME
2180 TALF(IP)=SALF
2190 306 CONTINUE
2200C
2210C START PRINTING Z TABLES
2220C
2230 PRINT 226
2240 PRINT 224
2250 JGA=JG+12
2260 PRINT 227,JGA
2270 GO TO (24,25,26,27,28),JG
2280 24 PRINT 218
2290 PRINT 202
2300 GO TO 29
2310 25 PRINT 219
2320 PRINT 203
2330 GO TO 29
2340 26 PRINT 220
2350 PRINT 204
2360 GO TO 29
2370 27 PRINT 220
2380 PRINT 205
2390 GO TO 29
2400 28 PRINT 221
2410 PRINT 206
2420 29 JH=1
2430 JX=5
2440 65 PRINT 207,N(1,JG)
2450 PRINT 208
2460 PRINT 209
2470 68 DO 307 IO=JH,JX
2480 PRINT 210,IO,TNME(IO),RKMN(IO,JG),ZTMP(IO),TALF(IO)
2490 IF(IO.LT.27) GO TO 307
2500 IF(IO.GT.27) GO TO 392
```

```
2510 GO TO 66
2520 307 IF(IO.LT.54) GO TO 307
2530 GO TO 67
2540 307 CONTINUE
2550 PRINT 222
2560 JH=JX+1
2570 JX=JX+5
2580 GO TO 68
2590 66 JH=28
2600 PRINT 209
2610 PRINT 223
2620 PRINT 226
2630 PRINT 225
2640 PRINT 226
2650 PRINT 224
2660 PRINT 228,JGA
2670 GO TO (74,75,76,77,78),JG
2680 74 PRINT 218
2690 PRINT 202
2700 GO TO 65
2710 75 PRINT 219
2720 PRINT 203
2730 GO TO 65
2740 76 PRINT 220
2750 PRINT 204
2760 GO TO 65
2770 77 PRINT 220
2780 PRINT 205
2790 GO TO 65
2800 78 PRINT 221
2810 PRINT 206
2820 GO TO 65
2830 67 PRINT 209
2840 PRINT 223
2850 PRINT 226
2860 PRINT 225
2870 350 CONTINUE
2880 STOP
2890 END
```

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